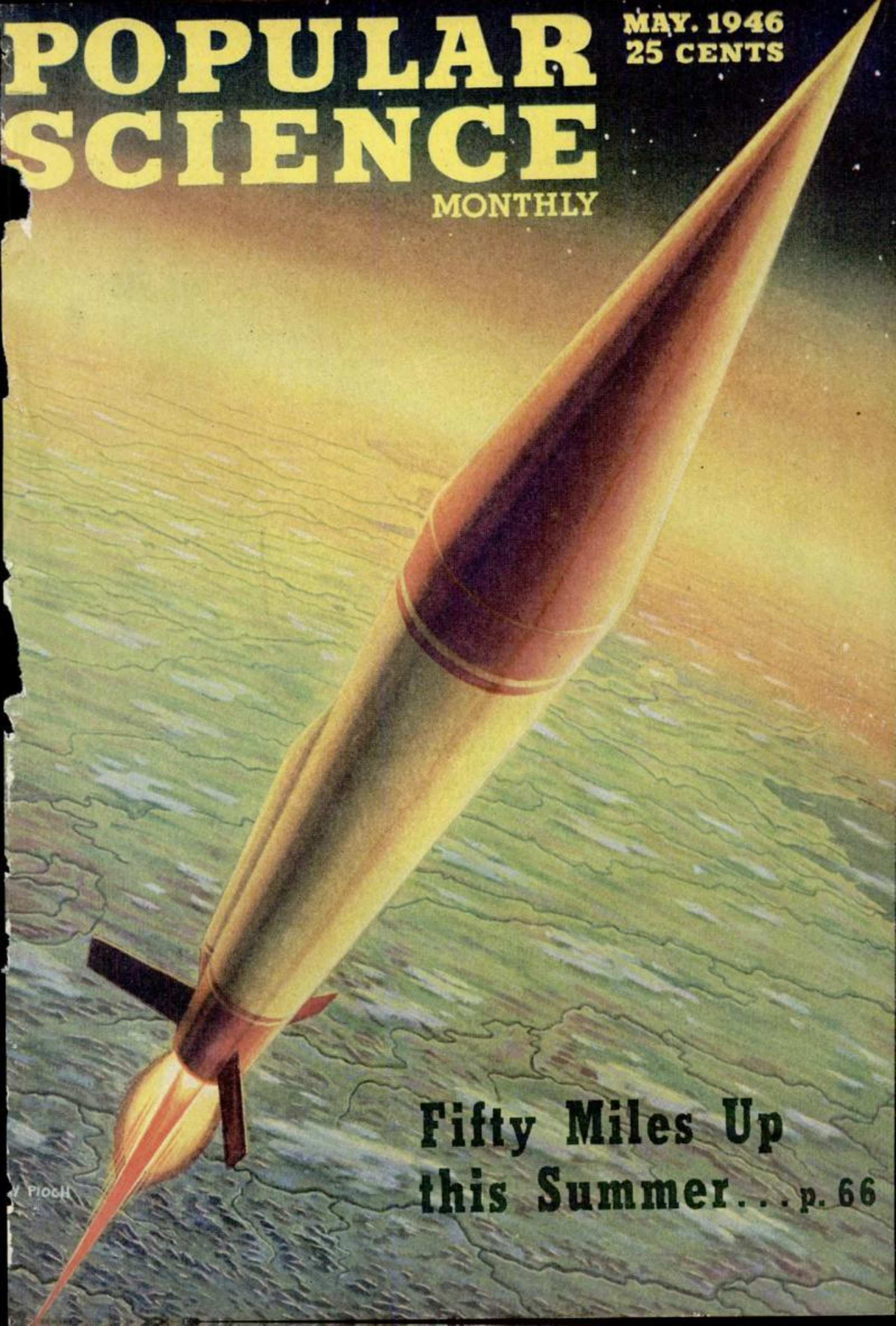
# POPULAR SCIENCE

MONTHLY

MAY. 1946
25 CENTS



## Fifty Miles Up this Summer... p. 66

SENSATIONAL BARGAINS WHILE OUR HUGE STOCK LASTS




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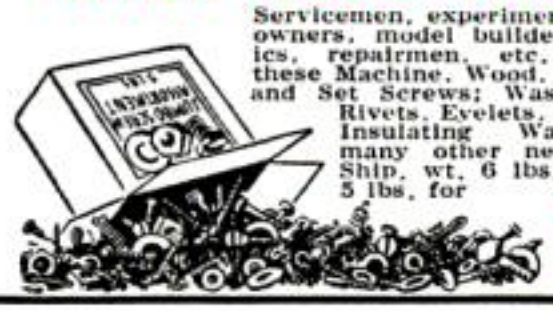
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# POPULAR SCIENCE MONTHLY

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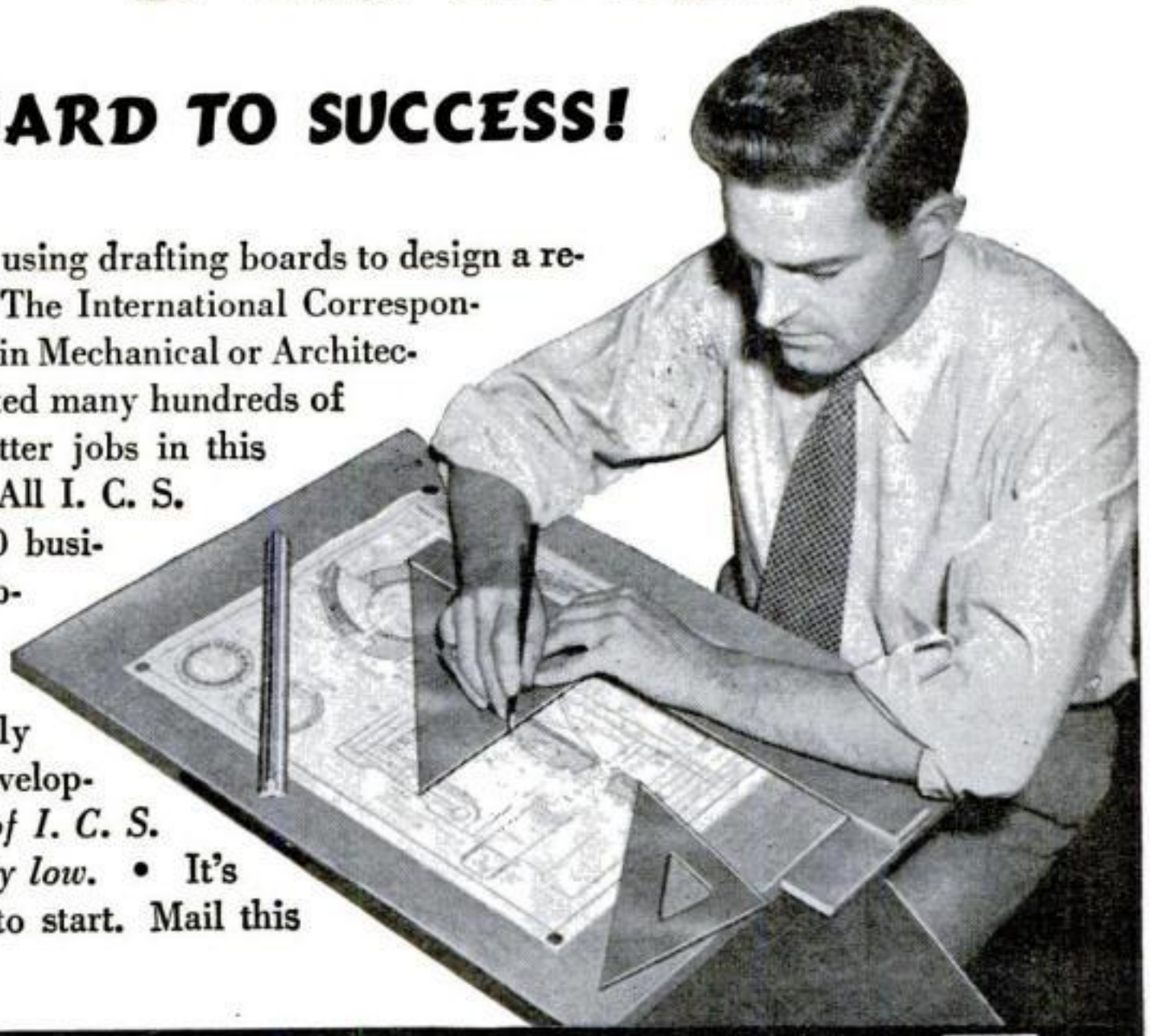


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## RADIO & ELECTRICITY

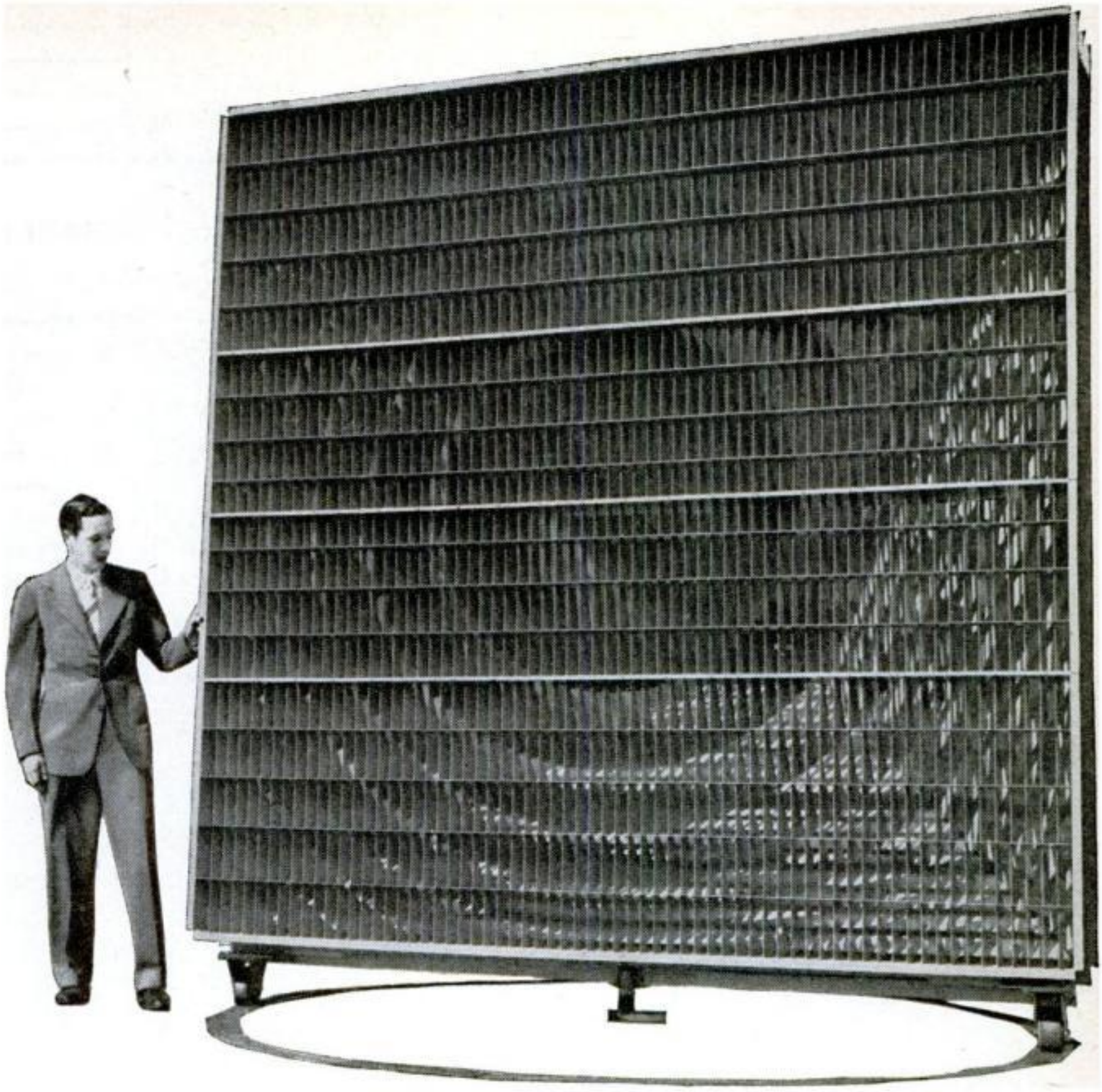

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## • A "SEARCHLIGHT" TO FOCUS RADIO WAVES

In the new microwave radio relay system between New York and Boston, which Bell Laboratories are developing for the Bell System, giant lenses will shape and aim the wave energy as a searchlight aims a light beam.

This unique lens—an array of metal plates—receives divergent waves through a waveguide in the rear. As they pass between the metal plates their direction of motion is bent inward so that the energy travels out as a nearly parallel beam. At the next relay point a similar combination of lens and waveguide, working in reverse, funnels the energy back into a repeater for amplification and retransmission.

A product of fundamental research on waveguides, metallic lenses were first developed by the Laboratories during the war to produce precise radio beams.

But how to focus waves is only one of many problems that Bell Telephone Laboratories are working on to speed microwave transmission. The goal of this and all Bell Laboratories research is the same — to keep on making American telephone service better and better.

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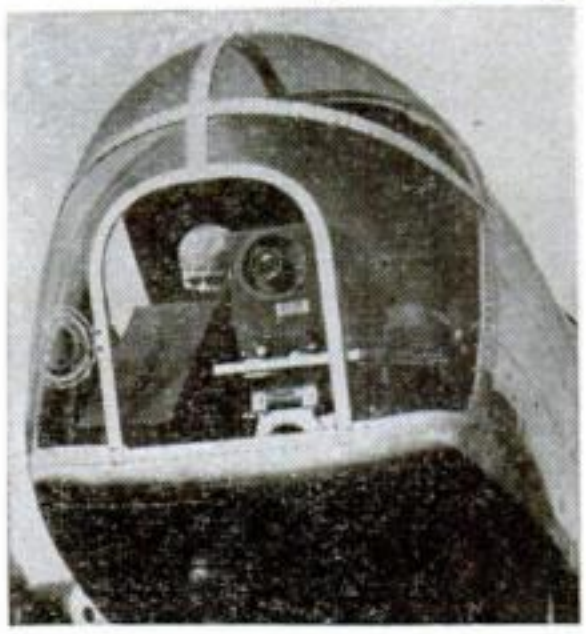
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POPULAR SCIENCE MONTHLY

VOICE OF SCIENCE

*(A Statement by the Editor of Popular Science Monthly)*

EARLY this year, the editors of this magazine initiated an investigation into atomic medicine as one of the first and perhaps most valuable by-products of the two-billion-dollar Manhattan Project. We knew that man's ills and pains are not popular unless they are personal. We knew that to get and to print the story would be difficult. But we also knew that the story had to be told, not only for itself, but as a test of the availability of all the vital and




valuable non-military information the scientist's searches and the people's money had purchased.

We assigned an able writer, Carl Dreher, whose own military experience made him very conscientious about military security. He researched and wrote a rounded and stimulating story. This was shown to some 40 scientific and medical people for their opinion. Their approval of the need and the article was gratifying.

To illustrate the article we could hardly send our own photographers into the secret reaches of Oak Ridge, so we asked the Army to furnish pictures of the non-secret protective devices used in the atomic-bomb plants and freely described in the Smyth Report and the public prints. The photographs were taken and sent to Washington for clearance. At this point General Leslie Richard Groves said, "No." No pictures. No pictures of any kind.

That is why there are blank spaces on page 93. More important, it is why there are blank spaces in the record of medical research. And why radio-iodine, for instance, goes smoking up the stacks of the Manhattan Project plants while thyroid cancer patients cost $10,000 to treat.

Ours is only one of many cases against General Groves. He has larger charges to answer. In the name of military security, he has discouraged every effort to apply the lessons of atomic research to the improvement of the civilian economy. He has blocked every move toward civilian control of atomic processes. And, in his own public testimony, he has convicted himself of a social stupidity that is outstanding even in a military man.

Yet, essentially, our quarrel is not with General Groves but with the generals—with the rubber-stamp minds that cannot, as a result of their leaning and training, answer an all-embracing question with a creative "Yes." We do not advocate that the hard-bought secrets of the atomic bomb be handed to Russia—or Iran. We do not condone treachery in Canada. But neither do we believe that the generals are fit custodians of science. Nothing so big should be controlled by anything less than the total of the people.

Certainly science cannot long endure its present state of arrest.

Paul Githeus



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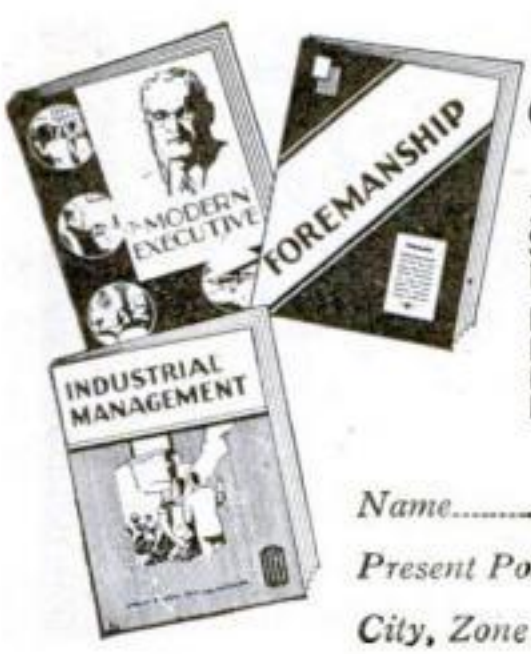
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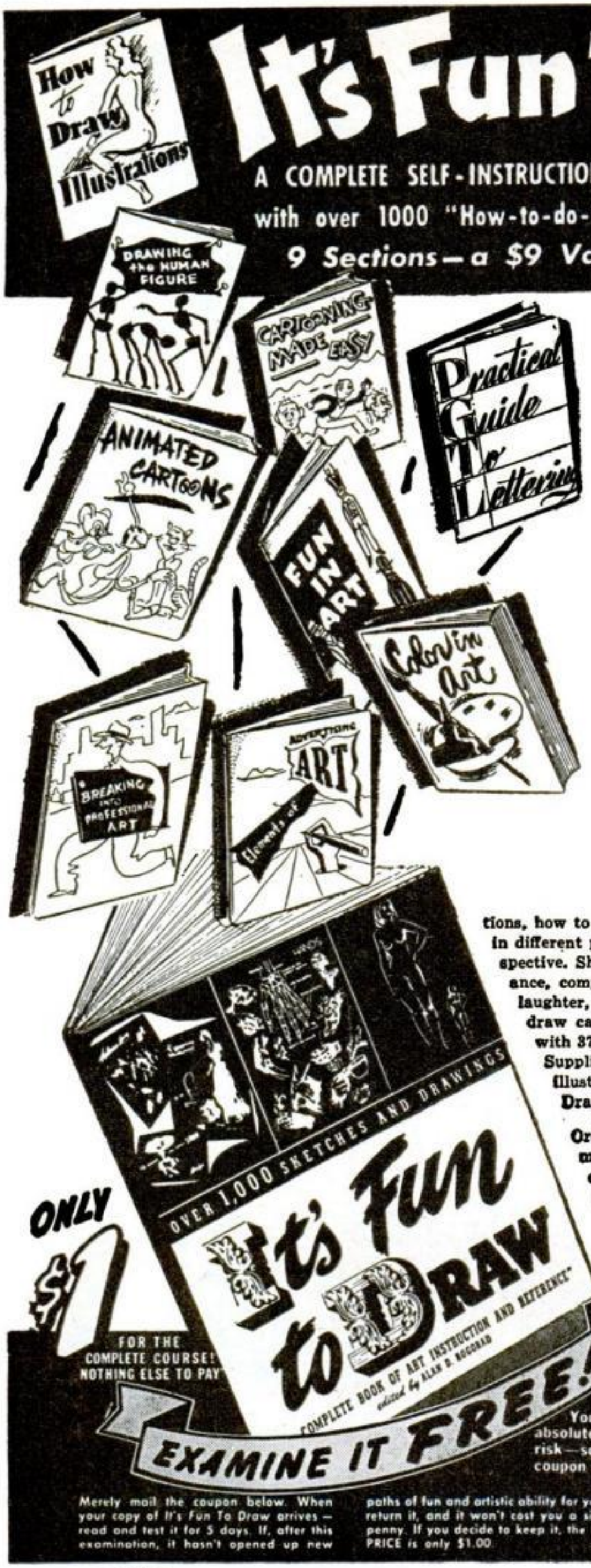




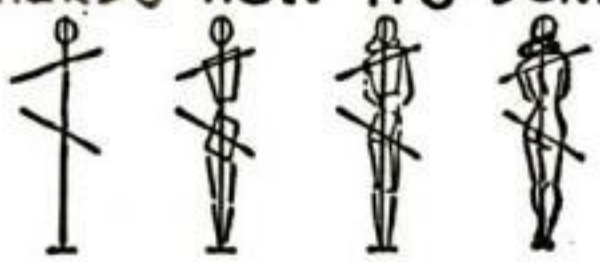

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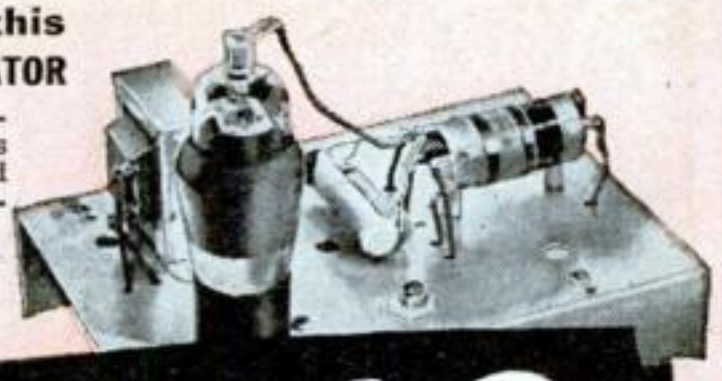


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# The Magic of Mind

WERE the great personages of the past victims of a stupendous hoax? Could such eminent men of the ancient world as Socrates, Pericles, and Alexander the Great have been deluded and cast under the spell of witchcraft—or did the oracles whom they consulted actually possess *a mysterious faculty of foresight?* That *the human mind can truly exert an influence over things and conditions* was not a credulous belief of the ancients, but a known and demonstrable fact to them. That there exists a wealth of infinite knowledge just beyond the border of our daily thoughts, which can be aroused and commanded at will, was not a fantasy of these sages of antiquity, but a dependable aid to which they turned in time of need.

It is time you realized that the rites, rituals and practices of the ancients were not superstitions, but subterfuges to conceal the marvelous workings of natural law from those who would have misused them. Telepathy, projection of thought, the materializing of ideas into helpful realities, are no longer thought by intelligent persons to be impossible practices, but instead, *demonstrable sciences,* by which a greater life of happiness may be had.

One of America's foremost psychologists and university instructors, says of his experiments with thought transference and the powers of mind—"The successes were much too numerous to be merely lucky hits and one can see no way for guessing to have accounted for the results." *Have you* that open-minded attitude of today which warrants a clear, positive revelation of the facts of mind which intolerance and bigotry have suppressed for years? *Advance with the times;* learn the truth about your inherited powers.

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But if you'll give *me* just FIFTEEN MINUTES A DAY—I'LL PROVE I CAN BUILD YOU A POWERFUL NEW BODY! I can make you feel so *strong* and *alive* you'll laugh at fatigue! Let me give you a battering-ram punch, develop your shoulders and back into a tough wall of solid muscle, build you a tough, supple belt of punch-proof stomach muscles, re-make your legs into young "tree trunks" of strength and flexibility. Let me pump *real HE-MAN power* into every part of your body. INSIDE AND OUTSIDE! Only 15 minutes a day—right in your own home!—is all I ask. And there's no cost if I fail.

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Just think what that will mean! You'll no longer have to stand back and let *other* fellows walk off with the prettiest girls, step into the best jobs, grab the spotlight at every party. YOU can now have the kind of handsome, healthy body and red-blooded HE-MAN VITALITY that spells SUCCESS in every way! You just won't be able to HELP attracting admiring looks wherever you go—winning instant attention—steadily forging ahead in life!

My method—"*Dynamic Tension*"—will turn the trick for you. No *theory*—every exercise is *practical*. And, man, *so easy!* Spend only 15 minutes a day in your own home. From the very start you'll be using my method of "*Dynamic Tension*" almost unconsciously every minute of the day—walking, bending over, etc.—TO BUILD MUSCLE and VITALITY.



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# LETTERS

## Lost Scientists

Sir:

Having just read your article on the "Lost Generation of Scientists" (PSM, Mar. '46, p. 88), I am writing to tell you of a case very dear to me, my own. I began college in September 1941 and received at the end of three years a most coveted B.S. degree in chemistry. . . . As a consequence of my induction on August 28, 1945, I lost a $1,200 fellowship. Also, I lost seven semester hours credit for my M.S. degree. . . . I estimate that because of my six months, thus far, in the Army, I have lost a year of work towards the advanced degrees I was striving for . . . Right now I am awaiting overseas shipment as a clerk, nontypist.

PVT. HARVEY N. HANTZES

Kearns, Utah

Sir:

My 18-year-old son left today to be inducted. In looking over his magazines, I read your article, "Lost—A Generation of Scientists." I think it was fine and true.

Now I appeal to you to help me get my son back in Purdue while he is still young and burning with the desire to become a scientist. He has completed three semesters and won the "distinguished student" honor.

(Name withheld by the editors)

*There is little PSM can do in an individual case. But to speed recognition of the total problem, reprints of the article in question have been sent to each Representative and Senator. In addition, reprints have been sent to several hundred outstanding scientists in the belief that it will provide them with an additional instrument in publicizing the gloomy prospect of America's scientific future.*

## Warns of Rot

Sir:

. . . There are a great number of organizations of "atomic scientists," and of scientists in this or that project, (which) have been formed since the atomic bomb became public. Some of these represent impartial scientific opinion, and others are groups of citizens who happen to be men of science and believe strongly that some particular solutions of the problems should be adopted . . . I quite agree with you that the atomic scientist is up to his neck in politics nowadays, and cannot help it, but an awful lot of rot has



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HENRY NORRIS RUSSELL
Princeton University Observatory
Princeton, N. J.

*To Dr. Russell, astronomer, author, and winner of many medals, PSM wishes to say that it proposes to spot the rot.*

## "Ivory Tower" Leans

Sir:

I like your statement: "The scientist must learn the language of the people" . . . There are signs that the exclusiveness of the language of the "ivory tower" is becoming obsolete.

ERNEST F. W. ALEXANDERSON
Schenectady, N. Y.

*With Edison Medal winner and General Electric scientist Alexanderson, PSM agrees that Hiroshima and the "ivory tower" were destroyed in one fell blow.*

## Believed in Brodie

Sir:

I noted an inaccurate reference to the National Inventors Council on page 98 of the March 1946 issue of Popular Science: ". . . the National Inventors Council and the Navy—to whom the idea was first submitted—refused to believe it."

. . . The Council certainly did believe in the Brodie System. This is evidenced by the fact that it was selected from the gross volume of ideas received and brought to the attention of the Army Air Forces and the Navy Department. I am sure that both of these services also believed in the technical feasibility of the project, but at that time could not see how it fitted in with their existing research program.

The National Inventors Council is not empowered to develop inventions brought to our attention. We are charged with the function of sifting potentially valuable and technically feasible ideas from the vast volumes received. The selected fraction is brought to the attention of the appropriate military groups for their investigation. We are not authorized and do not attempt to control their findings . . .

J. C. GREEN
Washington, D. C.

*Mr. Green, as Chief Engineer of the National Inventors Council, speaks with authority.*

## Smallest Houses

Sir:

In your March issue of 1946 there is an article on page 157 headed, "There's no place like home," about the Jay Barnums living in the smallest home in crowded Greenwich



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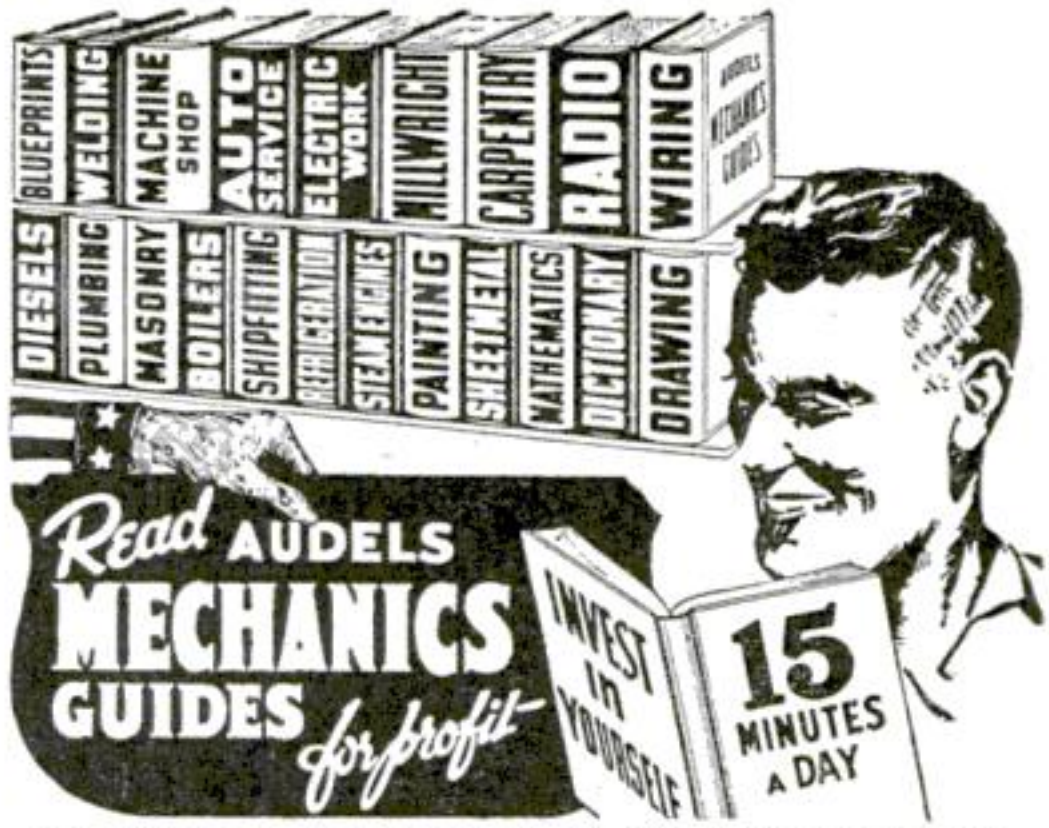
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ELMER A. ZIEMANN

Milwaukee, Wis.

*That is correct. Minimum in New York City is 8″. The Barnum residence actually has no walls of its own. Walls of buildings on either side support its roof and floors. That extra 6″ is devoted to fireplaces and other paraphernalia.*

Sir:

In your March issue . . . you showed a house 8½ feet wide . . . . . Please be advised that at 112½ Rodney Street, Brooklyn, N. Y., there is a brick house 7 feet wide.

W. APPLEBY

Brooklyn, N. Y.

*Our Brooklyn reporter overlooked this novelty. His face is brick red.*

## Distillers

Sir:

The bigger part of my work, as a chemical engineer, has to do with cleaning evaporators and condensers for power steam equipment. A few months ago I ran into two Kleinschmidt-type distillers, the first of their kind I had ever seen—one on an LST and the other on a Navy tugboat.

As it was a rush job, I had no time to send to the maker for a manual on their care and construction. If I had had your article, it would certainly have saved me quite a bit of time in figuring out the water circulating system. Since that time, I have seen the manufacturer's plans. Let me say that those in PSM are much easier to read.

W. C. HUGHES

Richmond, Calif.

*Compliments from practical men like Mr. Hughes are a constant inspiration to the editors who try to make Popular Science the most informative and accurate magazine of its kind.*

## No Excuse, Sir

Sir:

Having done my share of the radio and radar installation work on the *Midway* . . . I could not help but notice your error in the March issue (p. 82). You say that the framework overhanging the side just aft of the five-inch gun is used for lowering boats . . . It is one of the antenna masts . . . which can be lowered or raised at will.

E. W. LAKE

Hampton, Va.

*The PSM editor who handled the Midway picture story spent three years in the Navy ashore, afloat and in the air, but erred about this. He apologizes, sir.*



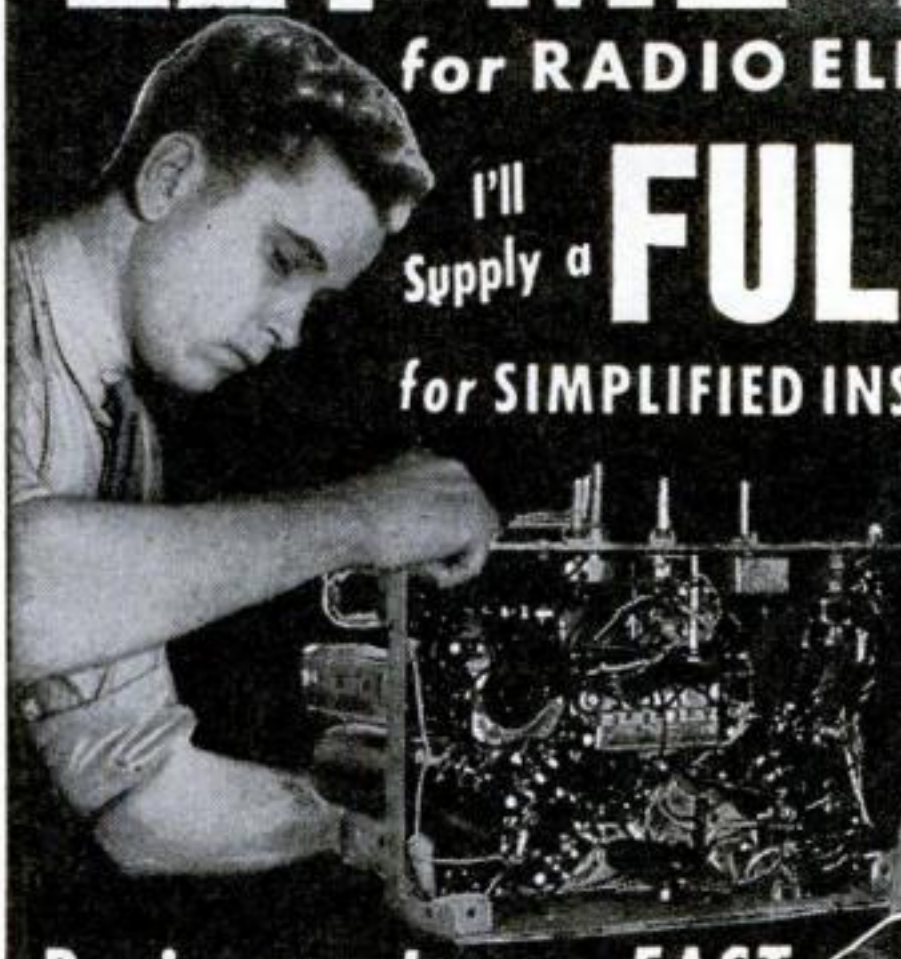
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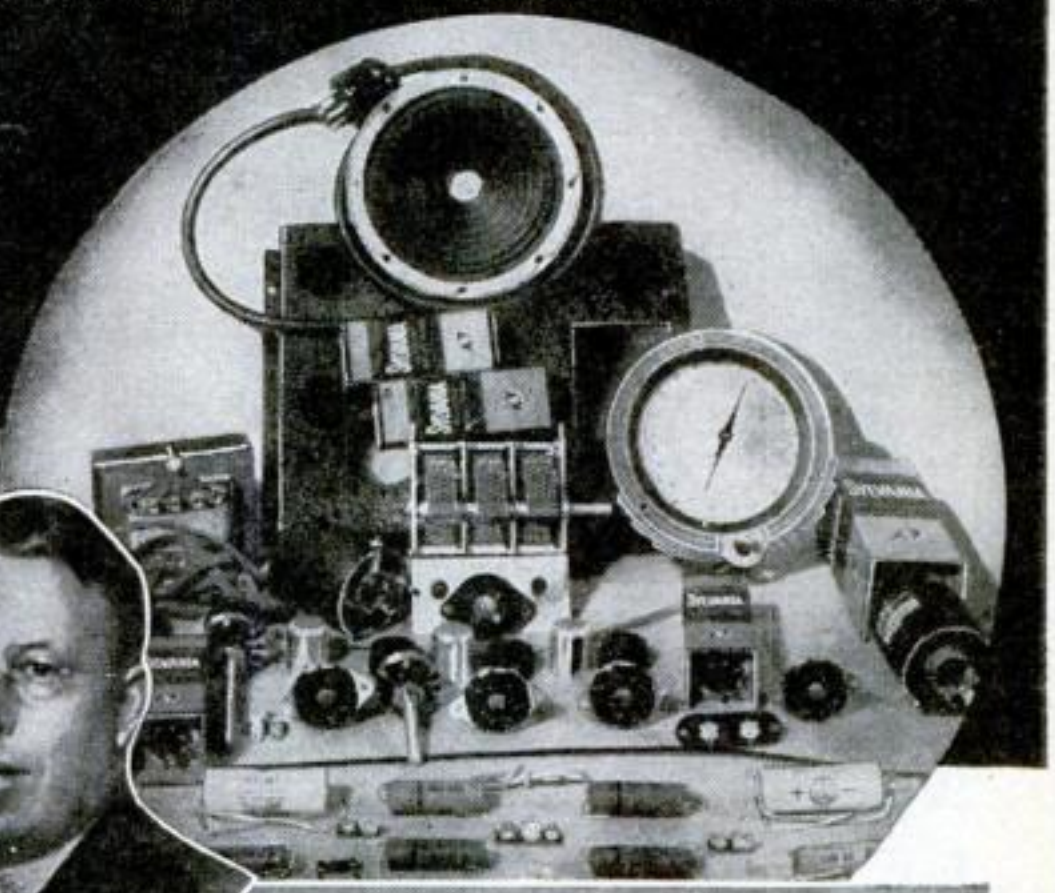
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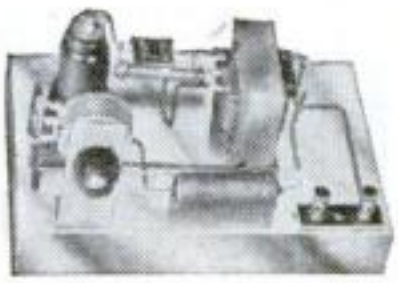
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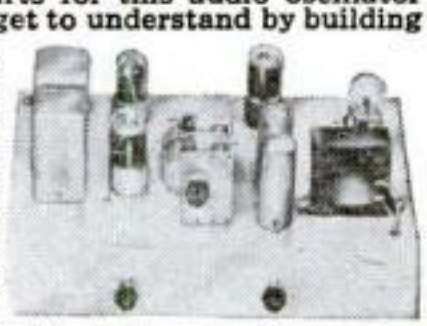
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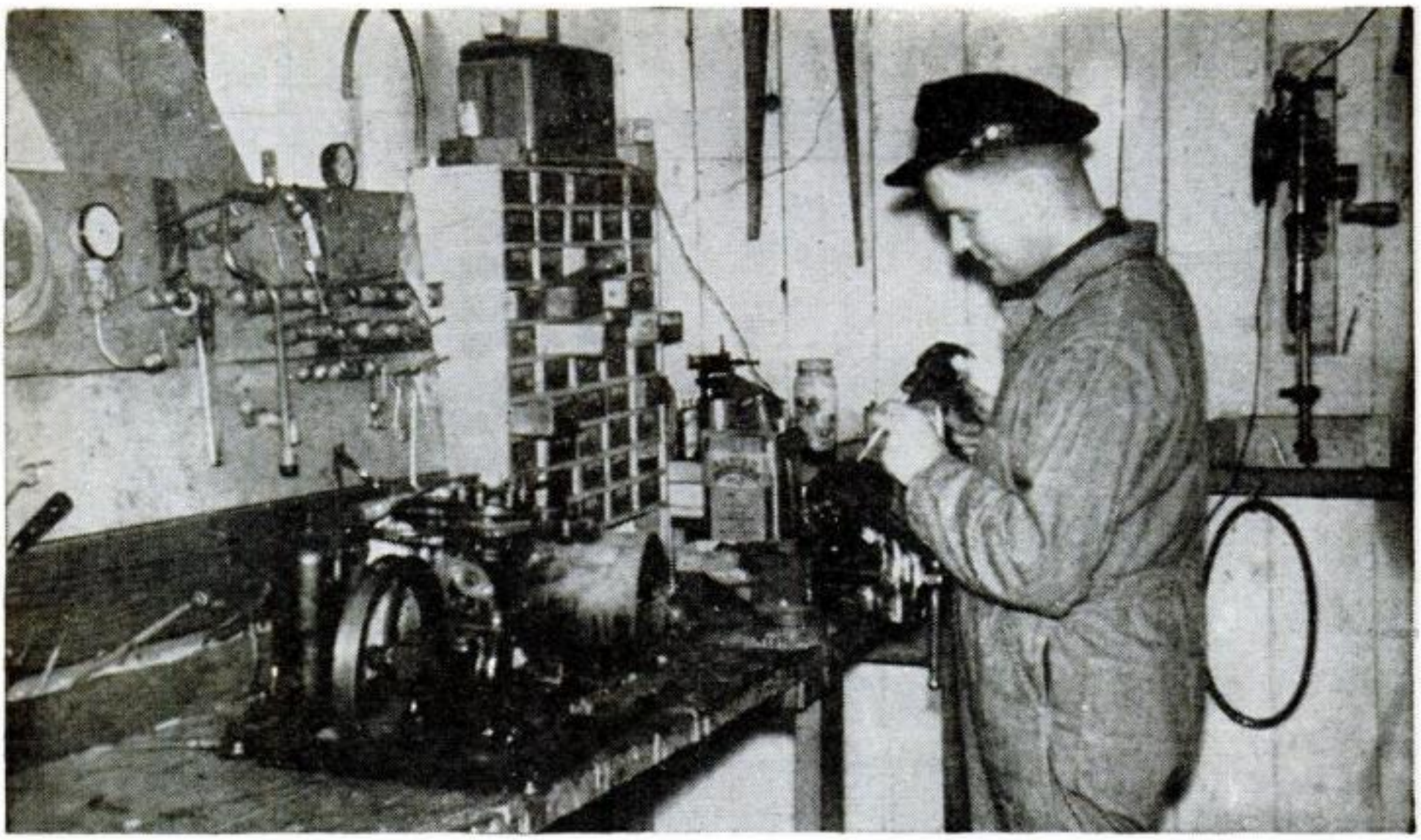
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# SO IT NEEDS FIXING

**By S. T. CHRISTENSEN**

*the "Fix-it Man"*

"WELL, I guess I'm the fellow to see, for I've repaired thousands of refrigerators (home and commercial both), vacuum cleaners, radios, washing machines, irons, fans, lamps, mangles, motors, etc. In fact, many of my customers call me their "electrical appliance doctor." And "doctoring," I might add has paid me a good substantial income for quite a few years. Funny, in a way, how I got started. Always liked to tinker and by experimenting around I found that most electrical appliances had many things in common. That, regardless of what the appliance was used for, or who the manufacturer was, the basic principles were much the same. From fixing my own appliances to fixing friends' and then for strangers at a fee, seems now to have been but a small step.

### What to Charge?

At first, I let the owner decide the charge and, frankly, I was amazed at what I earned per hour. But then, when one figures what initial costs are involved in buying most electrical appliances, one can readily see that spending extra dollars for repairs is well worth while. Before long I was making more in my spare time repairing than from my regular job. The result . . . I went into business for myself. When war came, business boomed, for new appliances were not available.

For a while, repair parts (needed on some jobs) were a little difficult to get. But that situation quickly adjusted itself and many repair parts were given the high priority rating of AA2. After all, we had to provide for the health and well-being of our civilian population.

### The Future Offers

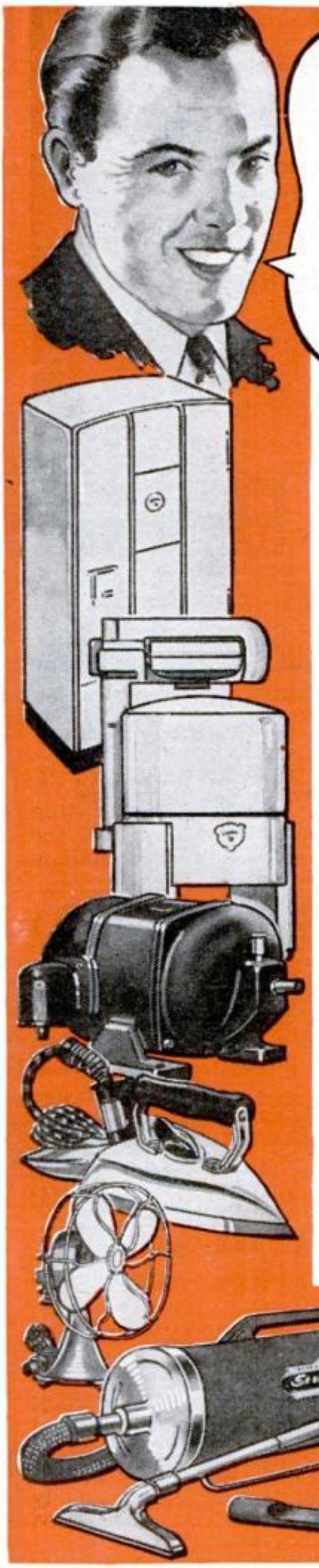
Friends ask me about my future. And, I think I've got a grand one. Age is no handicap in repairing. I have in my files enthusiastic letters from repairmen ranging in age from 18 to 79 years. Now the war is over we are certain to see hundreds of new products on the market . . . products that the average person never dreamt of. These new products and our old appliances are all going to need at some time or other "fixing." Well, I'll still be the fellow to do it. The field open for appliance repairmen is unlimited. I don't worry at all about too much competition.

### If You Are Ambitious

To the contrary, I've prepared a complete course, chuck full of simple, easy to understand photos and drawings and written in the same non-technical language as this article. I know the course is good, because I have hundreds of men all over the country writing to me telling me how the course has helped swell their pockets with cash. If you too want to prepare now for your future, I suggest you read the next page and send me the handy coupon." ADV.



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If you are at all mechanically inclined—can hold and use tools—then you have all of the qualifications required for becoming a big money earning home appliance repairman. It does not matter if you have not had a great deal of schooling or had previous experience along these lines—WE WILL TEACH YOU. Age should be no barrier—nor should any minor physical handicap.

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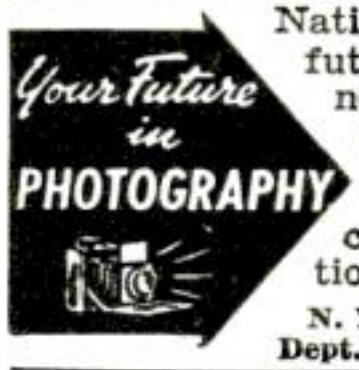
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# HAVE YOU THE COURAGE TO LEARN THE TRUTH ABOUT YOURSELF?

IF YOU ARE *honest* with yourself, you will admit that *something* must be wrong with you—or you would, by this time, have achieved *much* greater financial, social, vocational or professional success! You know it isn't a matter of education, for too many dull, uneducated, ignorant people have reached greater heights than you have, while at the same time too many brilliant, cultured, highly educated people are worse off than you are.

The truth is, you have, within you, *all the ingredients you need* to make you vastly richer in money, friends, position, public esteem and *self*-esteem—but somewhere in your make-up there are *brakes* which hold you back. These brakes may be habits of thinking which nullify the power you generate! You do not know what these brakes are, or what to do about them. You may recognize them in others, but you cannot see them in yourself. You are *too close* to yourself! You know *too much* about yourself! You find it too easy to *justify* everything you say and do! YOU ARE A HERO TO YOURSELF! In short, you make virtues of your vices, assets out of your liabilities, and "successes" out of your *failures!*

You have probably been "excusing" yourself and blaming *outside* forces for years. You will probably continue to do so for the balance of your life unless something or someone REVEALS YOU TO YOURSELF. When this happens, you will at least KNOW WHAT HAS BEEN HOLDING YOU BACK! But *until* this happens you will be working against unseen, unrecognized enemies—fighting IN THE DARK against vicious, sneering, laughing FLAWS IN YOUR WAY OF DEALING WITH OTHERS—if you fight at all! Have YOU the courage to learn the TRUTH about yourself?

## What the Truth May Mean to You

My name is James Maratta. My profession is that of Counselor in Human Relations. For 22 years I have devoted my time to the study of people—their actions and reactions. I have been retained by some of the largest Corporations in America to straighten out the thinking of their employees as related to the people with whom they come in contact.

I have traveled from one end of the country to the other, listening to the hopes, ambitions, and failures of men and women of all ages, in all walks of life, in every conceivable social, financial, vocational, and professional position.

I have analyzed thousands of business men, lawyers, doctors, storekeepers, clerks, housewives, salesmen, mechanics, and others who felt that *something* was holding them back. And I am now advising nearly 30,000 people a year on the subject of their right and wrong methods of dealing with others!

### What I Discovered About People

My whole experience points to the one unalterable fact that everything we accomplish in life is accomplished through our relations with other human beings. Whether we want more money, more love, more comfort, more authority, more leisure, more peace of mind, more security, more customers, or *whatever* it is, it *must come from other people*

You cannot do it alone, no matter how brilliant you are, no matter how much you read or learn, no matter how complete and thorough your education has been, no matter how skilful you may be. Unless you can *capitalize* on what you know, you will not advance much farther. We are not self-sufficient unto ourselves. Neither are *other* people self-sufficient unto *themselves*. They need *you* as much as you need *them*. But when there is conflict, or lack of complete harmony in thought and action, both parties suffer. And you wonder what is wrong with *you*.

There is really *nothing* wrong with you except your inability to understand how to gear your thinking to the thinking of the people you *want to do business with and who are eager to do business with you!*

When you fail to make a sale, or satisfy a patient, or get a vote, or increase your salary, or acquire a better job, or convince your wife, or win an argument, or convey instructions, you have failed to use the simplest and most effective weapon *at your command!* Let me tell you what this weapon is.

The first thing I do is to awaken you to the importance of *forgetting* about what you *think* are your own weaknesses. Then I tell you wherein your *strength* lies. I do not try to make you over, mentally, physically, or spiritually. I take you for what you are, just as I teach you to accept other people for what *they* are.

I reveal your mistakes in dealing with other people and show you how to avoid them. I show you why you, and the "other fellow," are far less important to each other than the objectives you both want to reach!

My analysis will simplify your ideas of what you should do *now*, and will clarify your planning for the future. It will help you determine whether or not you are following the path of least resistance in getting what you want from *people*—the only source of all the riches that can possibly come to you!

### Let Me Analyze You

If you have been worried about yourself, or if you feel that you are capable of far greater success than you have attained, let me check up on your processes of thinking.

Whatever your occupation, profession, or vocation—whether you are a banker, teacher, executive, clerk, laborer, housewife, storekeeper, owner of a small business—I believe sincerely that I can help you. Let me send you my Copyrighted Questionnaire. Your answers (boiled down to simple "Yes" or "No") will tell me what effect your methods have on others and what effect their reactions have on you.

I will then send you my three-page report. When you get it you will open your eyes! If you are like most of the 30,000 people I analyze every year, you will say I "hit the nail on the head." And the self-advancement advice I will give you may change the entire course of your life!

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My price for this analysis of your self-advancement assets and liabilities is only one dollar. That is all you pay. There are no instalments, no extra charges. And, though you may be surprised, shocked, startled at the revelations I will make to you, I guarantee that you will be satisfied. If not, I will refund your dollar at once.

Yes, if you don't think I have told you the truth about yourself, if you don't feel sure that the advice I have given you about your dealings with *people* is worth a dollar—just tell me so and your dollar will be sent right back to you. You have nothing to lose.

But if what I tell you helps you—as it has helped tens of thousands of others—you will say your investment was the most profitable one you ever made, or ever will make!

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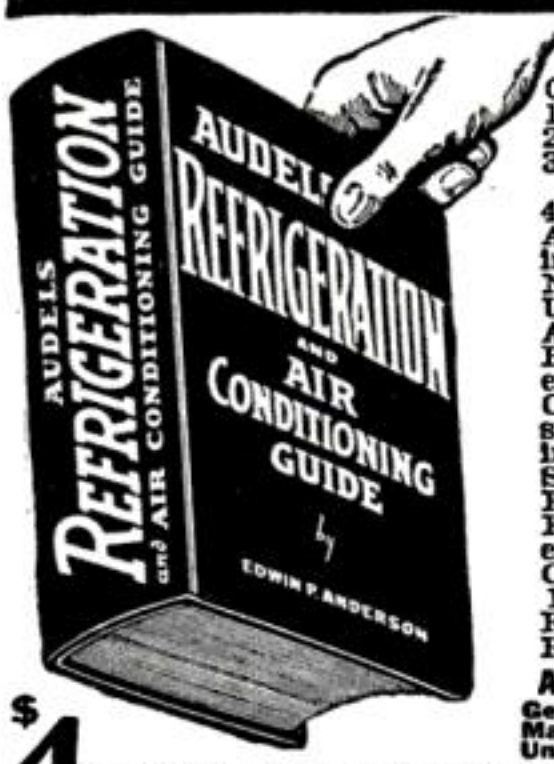
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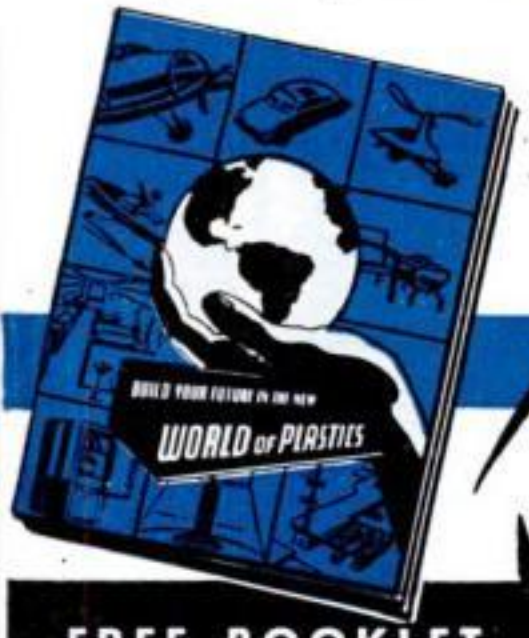
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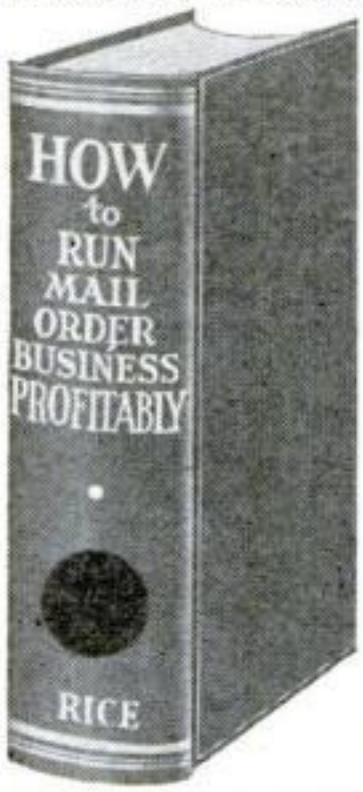
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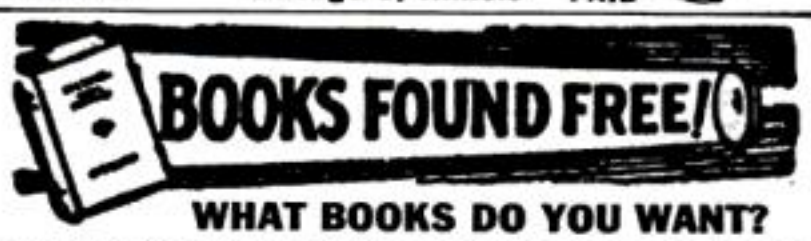
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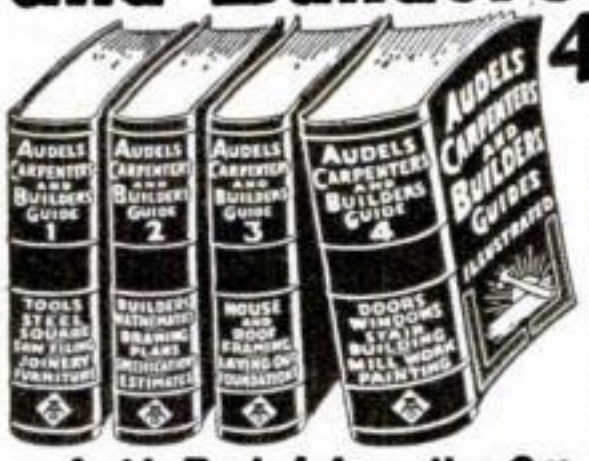
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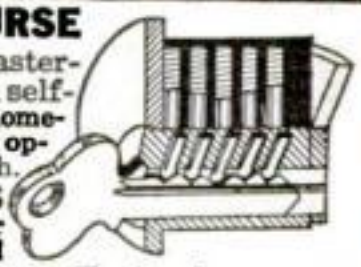
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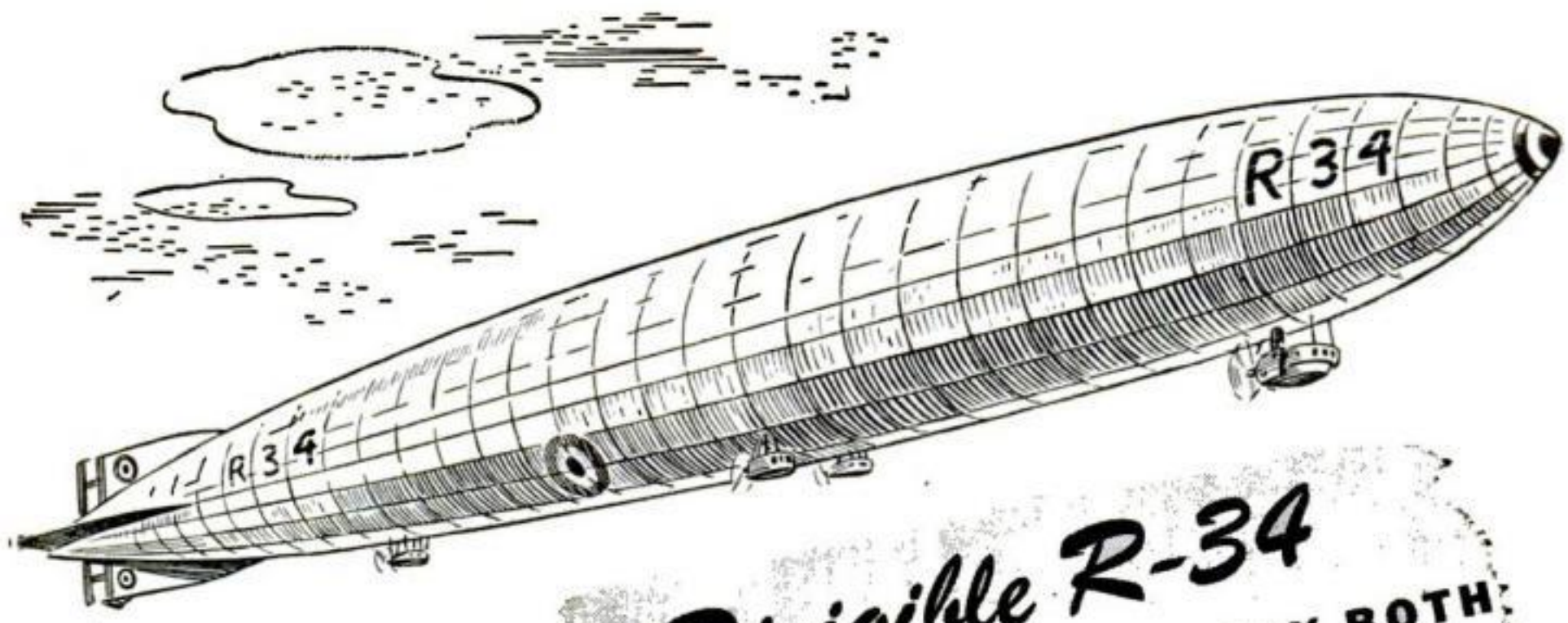
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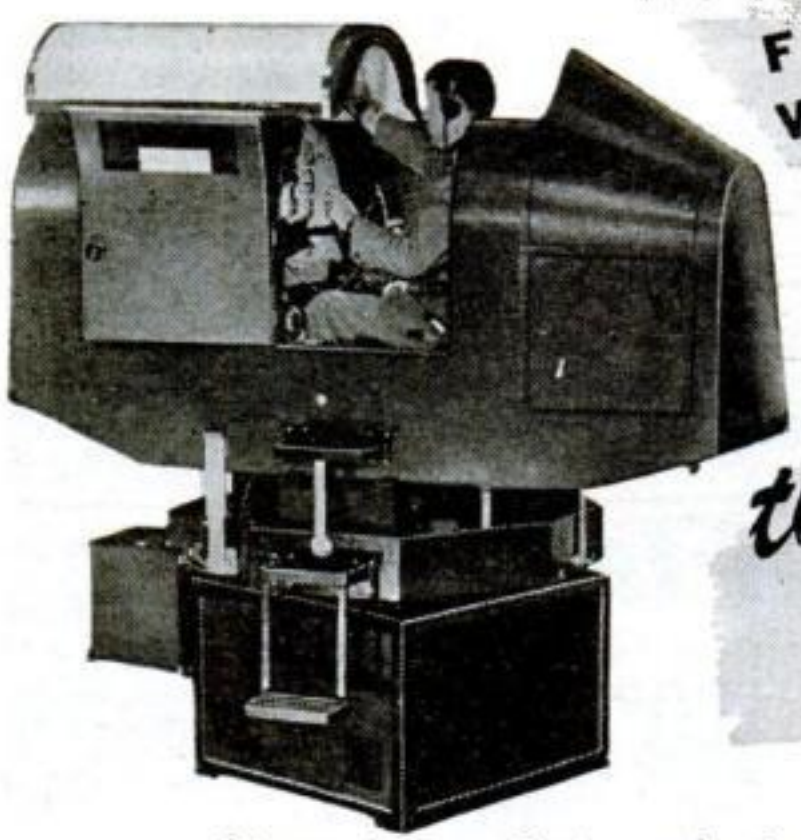



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POPULAR SCIENCE MONTHLY
MAY 1946



# BOARDS BIGGER THAN TREES

**If this 78-foot plywood panel isn't long enough, house builders and boat makers can call for still bigger boards made possible by war-proved resins and advanced jointing techniques. For a detailed story of the growing low-pressure molding industry, of which plywood is a big branch, see "Plastics Go Big" on page 122.**

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# 50 FIFTY MILES UP

## This Summer "Wac Corporal" Leads Assault on Ionosphere to Increase Our Knowledge of Weather and Radios

By JAMES L. H. PECK and KENYON KILBON

"WAC CORPORAL" is a slender rocket with an important research mission in the ionosphere. She already has streaked to altitudes of nearly 50 miles above her base at the White Sands Proving Ground, Las Cruces, N. M., to send back information from the lower fringe of the ionized layers surrounding the earth.

This summer, the Corporal and her sisters, the Wac Sergeant and Wac Private, are scheduled to zoom into the atmospheric desert lying from 35 to 500 miles above us on voyages that may be as historic as those of Christopher Columbus's three tiny ships in 1492. They will seek data needed to improve radio techniques, forecast the weather, and solve riddles as ancient as human thought.

The Corporal is a half-ton cylinder built of steel, aluminum and magnesium. From the tip of her needle-sharp nose, shaped to penetrate the shock waves that build up at supersonic speeds, she stretches 16 feet 2 inches past three stabilizing fins to the end of her rocket tube. Into her slim barrel, only 12 inches in diameter, are packed radar and secret devices designed to gather and transmit data to the base station during flight. These robots will be her only passengers when her masters step back from the steel framework that holds her upright on a concrete base in the desert and watch a flaming jet carry her into the unknown.

Scientists will send a great barrage of rockets into the upper layers of the atmosphere within the next few months. In addition to the Wacs, they have other highly secret projectiles, and plans call for the use of 25 reconstructed German V-2s. One U. S. rocket is reported to be able to reach the

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80-mile level. The Wac Corporal already has climbed to 230,000 feet—43½ miles—and the V-2 is said to have reached heights of 60 to 75 miles over horizontal ranges of 200 or more miles during its wartime missions. With its energy directed toward attaining absolute altitude, V-2 may go higher.

Improved combustion chambers and fuel systems have been devised to fit the rockets for their long-range research flights. Although the details of those actually in use remain secret, patents recently granted to the late rocket-pioneer, Dr. Robert H. Goddard, of Clark University and Roswell, N. M., bring sparkles to experts' eyes. The patents cover a fuel system using gasoline and liquid oxygen, and a combustion chamber that spins like a top as the fuel burns. The fuel system has a small tank of liquid nitrogen enclosed in the oxygen container. The nitrogen is piped through a coil around the combustion chamber as a coolant, returning it to a gaseous condition. The gas is then piped to the gasoline tank, where it is used to maintain pressure equilibrium as the gasoline is withdrawn. The spinning combustion chamber, mounted in ball bearings, provides more rapid and efficient combustion.

Ingenious instruments and methods have been contrived, too, to speed data back to earth from the rockets. Radar can track the projectiles at their supersonic speeds, and sections of a rocket can be detached by radio control to parachute recording instruments down. These will include ozone analyzers and versatile ionization meters which gather facts about cosmic and ultraviolet radiation. Special glass-lined chambers which open and reseal automatically have been built to bring back samples of the upper atmosphere. Some of the rockets also may carry compact, wide-angle infra-red cameras to photograph the earth from extreme altitudes.

A few of the rockets may be destroyed by shattering collisions with meteors in the rarefied upper air. From 75,000,000 to 10,000,000,000 meteors are believed to enter the earth's atmosphere daily, at speeds as great as 180,000 miles an hour. Most of them are eliminated by friction in the atmosphere before they strike the earth, but a rocket penetrating to great heights runs the risk of encountering one still massive enough to be destructive.

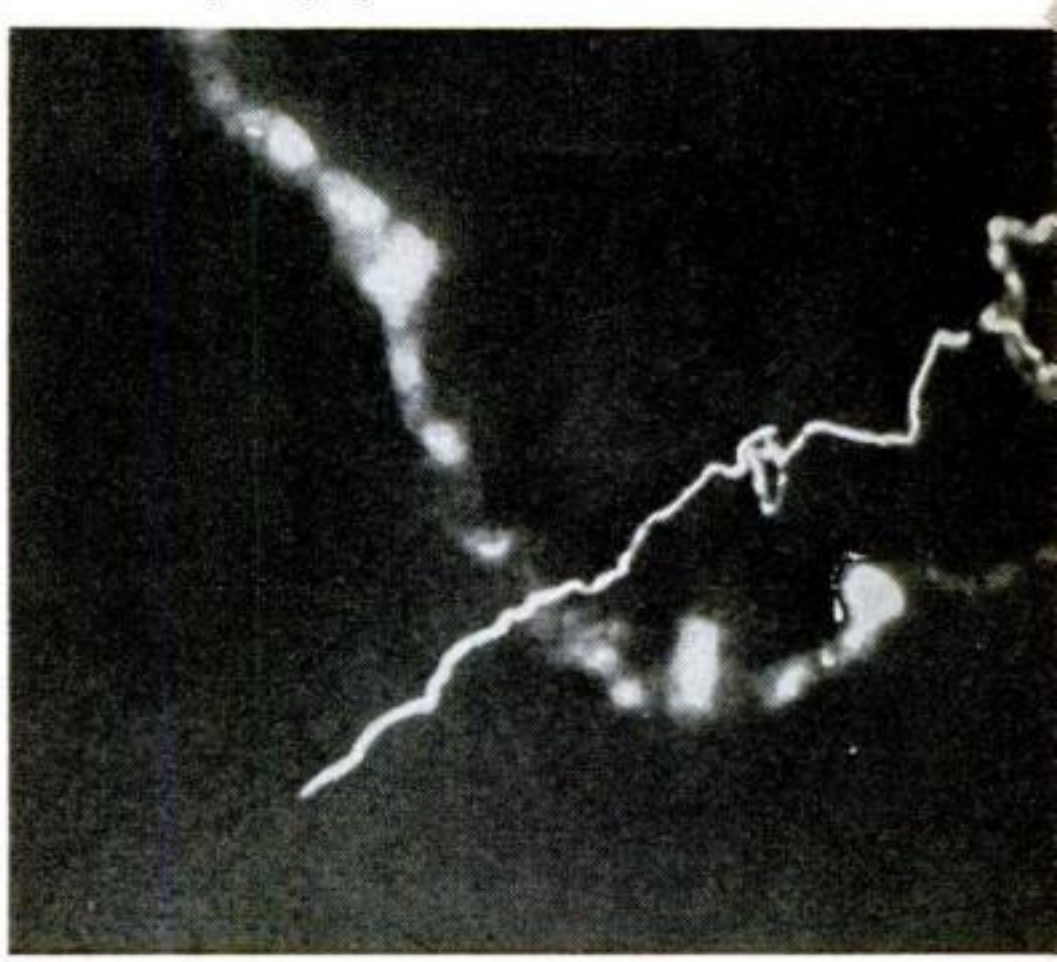
The evidence brought back by the rocket-borne instruments may affect many of our theories and deductions about the earth's atmosphere. Scientists now picture a series of adjoining layers surrounding the globe. They have designated the known layers by the letters C through F, beginning at the earth's surface, allowance having been made for the possible designation of additional levels below C or above F.

The outer layers, D, E and F, show the effects of constant exposure to the bombardment of ultraviolet radiations and charged particles from the sun, the stars and even meteors. If it were not for the atmosphere, the intense radiation would extinguish life on earth, but the coating of air filters and absorbs them to the point of safety. In the process, however, the outer atmosphere takes on the peculiar characteristics that identify the ionosphere.

When the ultraviolet light from the sun encounters the gaseous atoms of the outer air, ionization takes place on a grand scale. The result is not an explosion such as men have obtained from atomic fission, but a steady process of electron detachment and recombination among the atoms of the rarefied atmosphere. Under the bombardment, electrons are torn from their atoms, leaving the outer air filled with free electrons and unstable atoms, or ions, which attract one another and tend to rejoin because of their opposite charges. Where the atmosphere is rare, distances between atoms are relatively great, and recombination does not take place as rapidly as in the denser air of lower altitudes.

This vast ionized region was studied independently in 1902 by an American and a Briton, who found that it reflected radio waves transmitted from the earth. They discovered that the waves, encountering the electrified fields far above the earth, were refracted or bent around to return to earth

Though the "Wac Corporal" was roaring straight up when this picture was taken by an Army newsreel cameraman at the New Mexico tests, its exhaust trail looks erratic. That is because it was blown by varying winds at different altitudes.





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again, perhaps at great distances from the point of origin. In honor of the two scientists, the ionized region was named the Kennelly-Heaviside Layer.

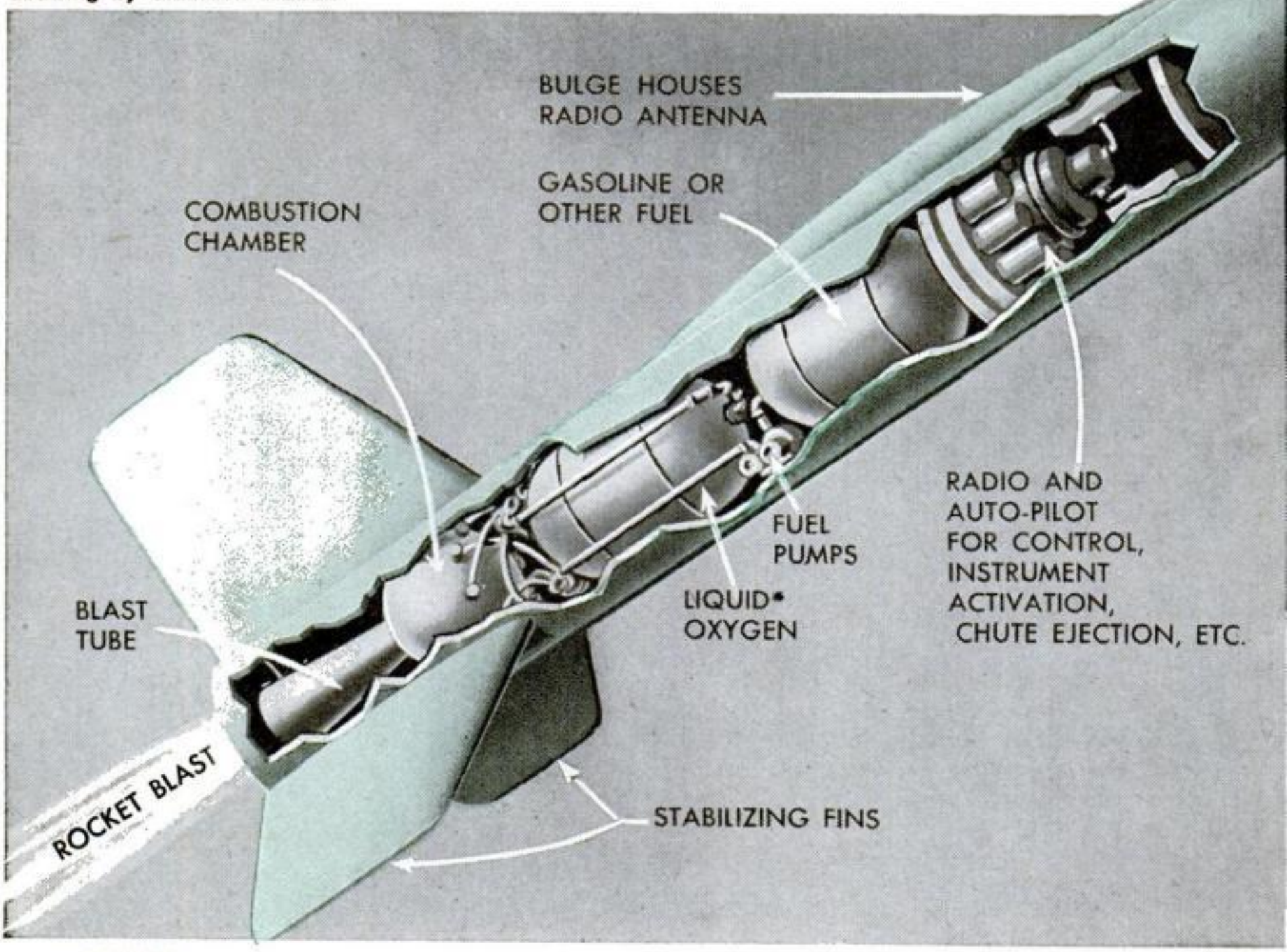
Later research disclosed that ionization in the upper air did not occur uniformly, but in strata, with the upper layers more intensely ionized than those nearer the earth. Radarlike "ionosphere recorders," capable of sending high-frequency radio waves through the electrified regions, revealed the approximate depth of each of the layers, and the present conception of the ionosphere resulted. The high-altitude sounding rockets will bring back more accurate information.

If not already built, a super-rocket capable of reaching the topmost layer is likely to be developed soon. Such a rocket, fired from a vertical launching rack, will streak up to the C layer, from 20 to 35 miles above us. There it may encounter a small amount of ionization, but it will not be in the true ionosphere until it enters the D region, about 35 miles up. Flashing through D, which reaches on to 50 miles, the super-rocket will record ionization strong enough to reflect long-wave radio transmissions of low frequency between 20 and 500 kilocycles during the daylight hours when solar radiation is present. During the hours of darkness, the D layer almost entirely disappears.

Above the D layer, the rocket will penetrate the E region, the original Kennelly-Heaviside Layer, which extends on upward to about 90 miles. Here instruments in the rocket will record ionization that still is relatively weak, although stronger than that in the D layer. During daylight, medium-wave broadcasts between 500 and 1,500 kilocycles—the commercial band on your home radio—are absorbed by the E layer. At night, with the interruption of solar radiation, ionization in this region, too, virtually disappears, permitting long-distance night-time transmission of "broadcast" waves by F layer reflection. During the summer months, the rocket also may encounter a ghost region called the "sporadic E," which appears unpredictably and frequently at altitudes as low as 60 miles.

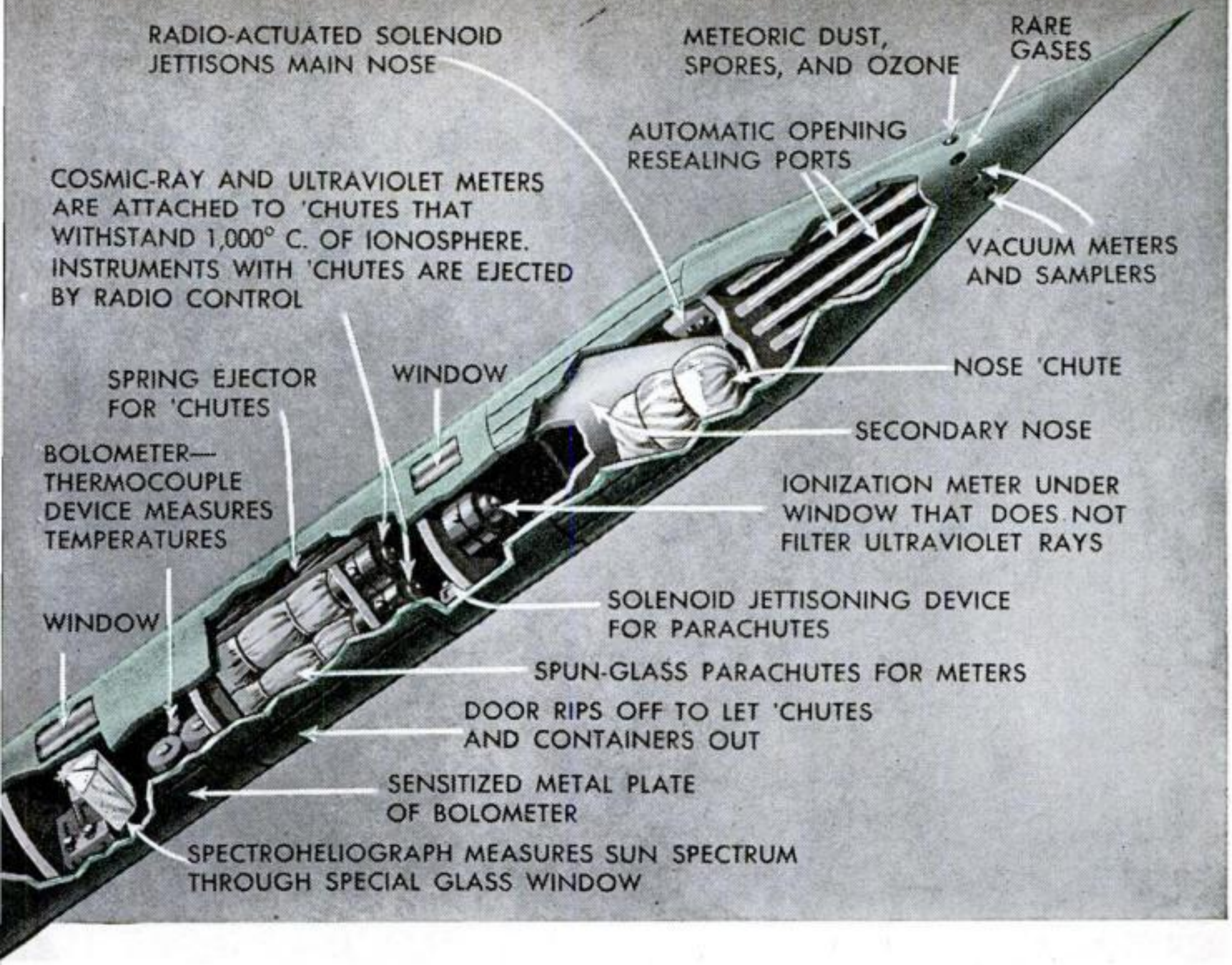
Above the 90-to-100 mile level, the super-rocket will bore into the F region, which scientists believe to be the outermost ionized layer. During daylight, F consists of two layers, and the rocket will enounter first the $F_1$, or Appleton, layer, whose lower limit averages about 100 miles of altitude. Beyond it, starting at 160 to 220 miles, depending upon the season, the rocket will penetrate $F_2$, extending outward to perhaps 500

*Drawing by STEWART ROUSE*






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miles. At night, the two layers merge into a single belt whose lower surface is about 170 miles up. At this altitude, the atmosphere is so rare that recombination of ions and free electrons takes place slowly, leaving sufficient ionization during darkness to reflect the short-wave transmissions of more than 1,500 kilocycles that pass through the lower ionized layers.

Beyond the F region, where the temperature may rise to 1,000° C., the rocket will find incredible cold and silence. The temperature in that stellar space, scientists believe, is always -459° F., the "absolute zero" at which all molecular motion ceases and through which only things that need no conducting medium may pass.

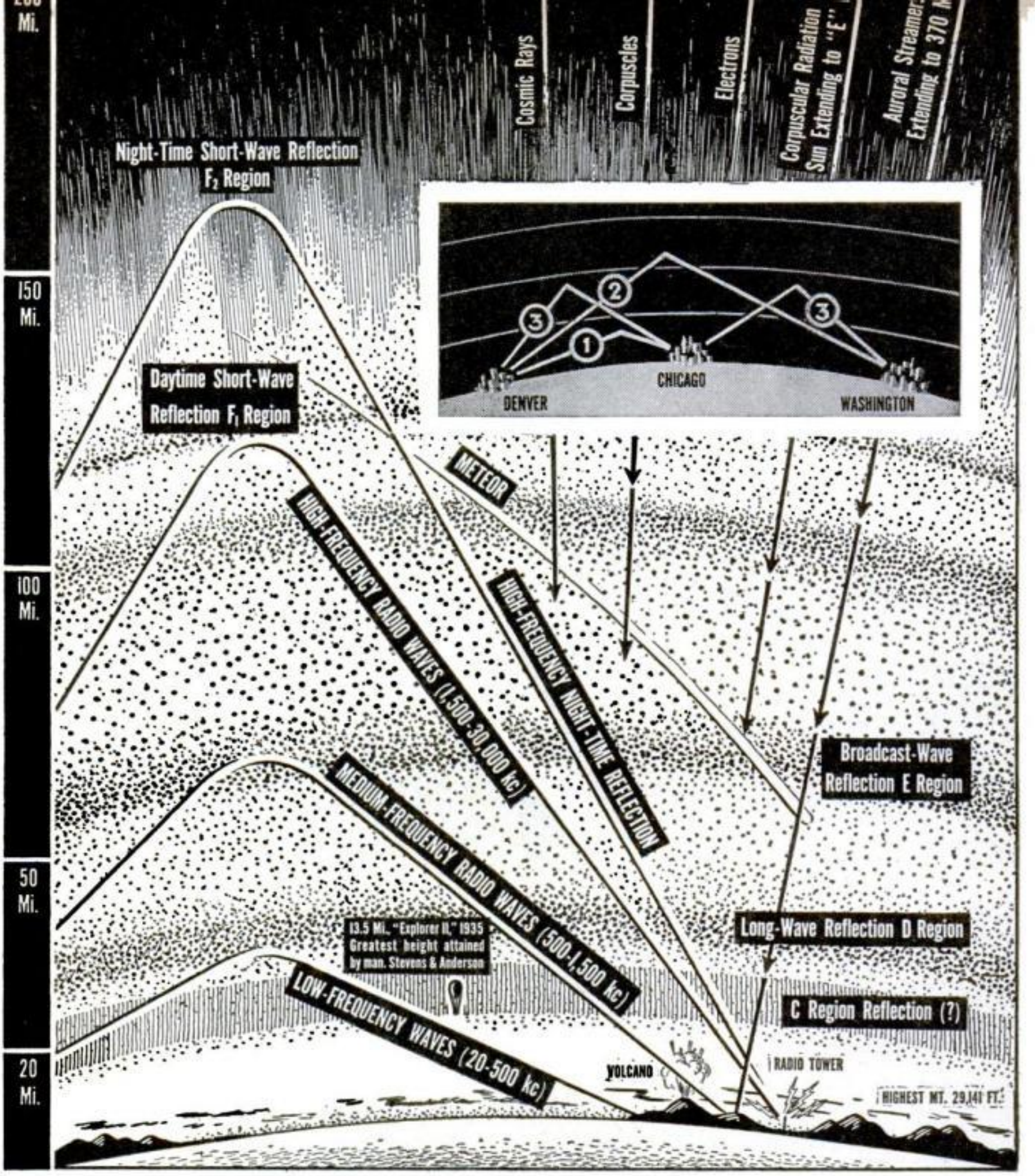
Already the outermost limits of the ionosphere have been left behind by high-frequency radio waves, including those of the ionosphere recorder and the famous "moon radar." One of the most significant features of radar contact with the moon, incidentally, was its demonstration that the ionosphere can be penetrated from the outside by radio waves. This has stimulated research regarding proposals to "bounce" signals off the moon from one city to another on earth.

The sounding rockets, with their unprecedented vertical range, should reveal much about the nature of the ionosphere as a shield protecting the earth from the intense bombardment from outer space. The filtering action of the ionized layers on external radiation is believed to be similar to that affecting radio waves from the earth. Certain of the cosmic radiations are absorbed or reflected by the F and E layers, while others are able to penetrate only in quantities harmless or beneficial to life. Cosmic rays, which may have some influence on life by disturbing hereditary factors in organisms, arrive from unknown distances with force enough to penetrate the ionosphere, but even they are filtered to the point of safety.

Periodically, the ionosphere is disturbed by tremendous magnetic storms. During these cycles, scientists have discovered, there is actual contact between the earth and the sun, which sprays forth great streams of charged particles that reach the earth's outer atmosphere in about 30 hours. The electron stream is believed to gain its terrific velocity from a powerful magnetic field around the gaseous whirlpools sometimes visible as sunspots. The additional ionization caused by these particles in the ionosphere is believed to be the reason for the spectacular aurora borealis and its



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This cross-section drawing shows the layer-cake pattern of the atmospheric regions girdling the earth. Using these layers of ionized air, radio transmission becomes like an electronic game of three-cushion billiards in which low-to-high-frequency waves are "banked" to points beyond the horizon (see inset) —often halfway around the globe. "Wac Corporal" and other super-rockets will explore the make-up of these regions.

southern companion, the aurora australis. The sensitive ionization meters in sounding rockets sent aloft during such magnetic storms may record the exact degree of added electronic activity and disclose for the first time the mysterious nature of the aurora.

Analysis of the auroral colors already made from the ground indicates electrical discharges in oxygen and nitrogen particles as the cause of the fireworks, which reach down into the D layer and rise as high as 250 miles. The aurora borealis, incidentally, has shown an unusual shade of green which was once thought to represent a new element. However, this has been positively identified as a radiation from atomic oxygen, this particular color occurring only in the relatively undisturbed conditions characteristic of the outermost portions of the earth's atmosphere.

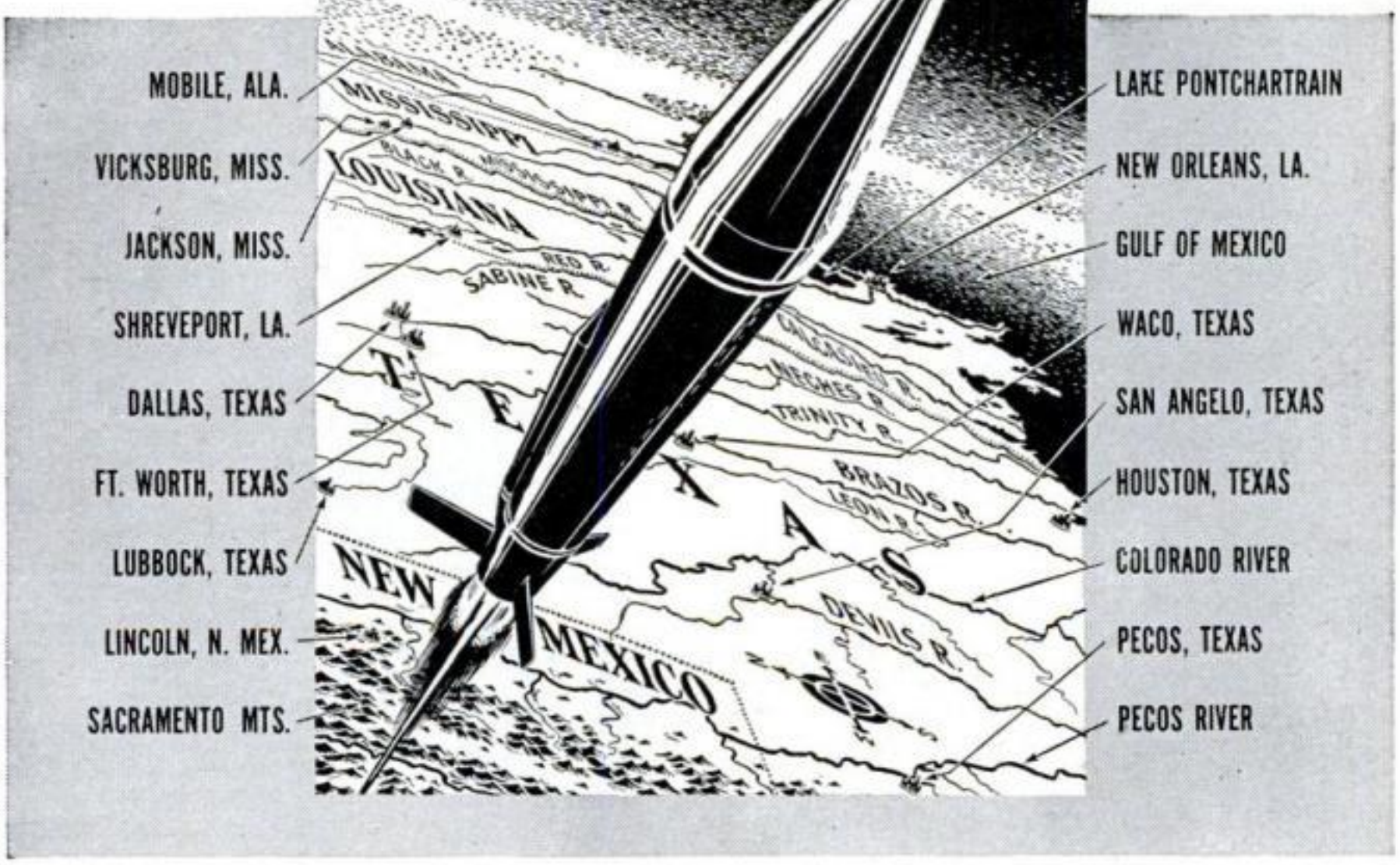


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Another important mission of the sounding rockets will be to measure temperatures at various levels. Estimates of atmospheric structure already have been made under laboratory conditions, but the scientists are anxious to check their results against precise measurements by instruments borne into the upper air.

Whether the rockets will provide the answers to all of the mysteries remains to be seen, but science is placing great faith in them. Work continues at the Jet Propulsion Laboratory at California Institute of Technology, where civilian specialists and Army ordnance experts developed the Wac Corporal and her secret sisters as a part of the "Ordcit" (Ordnance-California Institute of Technology) program under the general direction of Dr. Theodore von Karmen, aided by Col. B. S. Mesick. The aviation industry is involved in the picture, too, for the Corporal was constructed at the Douglas Aircraft Company plant in Santa Monica, California.

The assault on the ionosphere does not depend on the rockets alone. Intensive research into ionospheric phenomena is under way in earth-bound laboratories, including the Interservice Radio Propagation Laboratory at the National Bureau of Standards in Washington, Harvard University's Cruft Laboratory, the Cosmic Ray and Radiation Laboratory of Massachusetts Institute of Technology, the laboratories of the Department of Research in Terrestrial Magnetism at the Carnegie Institution of Washington, and in laboratories in England, Canada and Australia. The Army already is operating a world network of observation posts established during the war to study ionospheric conditions for the benefit of long-range radio communication. Science has just started going "out of this world" to probe the make-up of the heavens.




## *Notice* to GI HANDICRAFT CONTESTANTS

**Judging of the many entries in the Servicemen's Handicraft Contest, which closed at 6 p. m., April 30, will take place on June 6 and 7 in New York City. All winners will be notified immediately after the completion of judging.**



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# X rays ANALYZE CHEMICALS AND MAKE THEIR OWN REPORTS

## Electronic Apparatus Saves Time and Test Tubes for Industry.

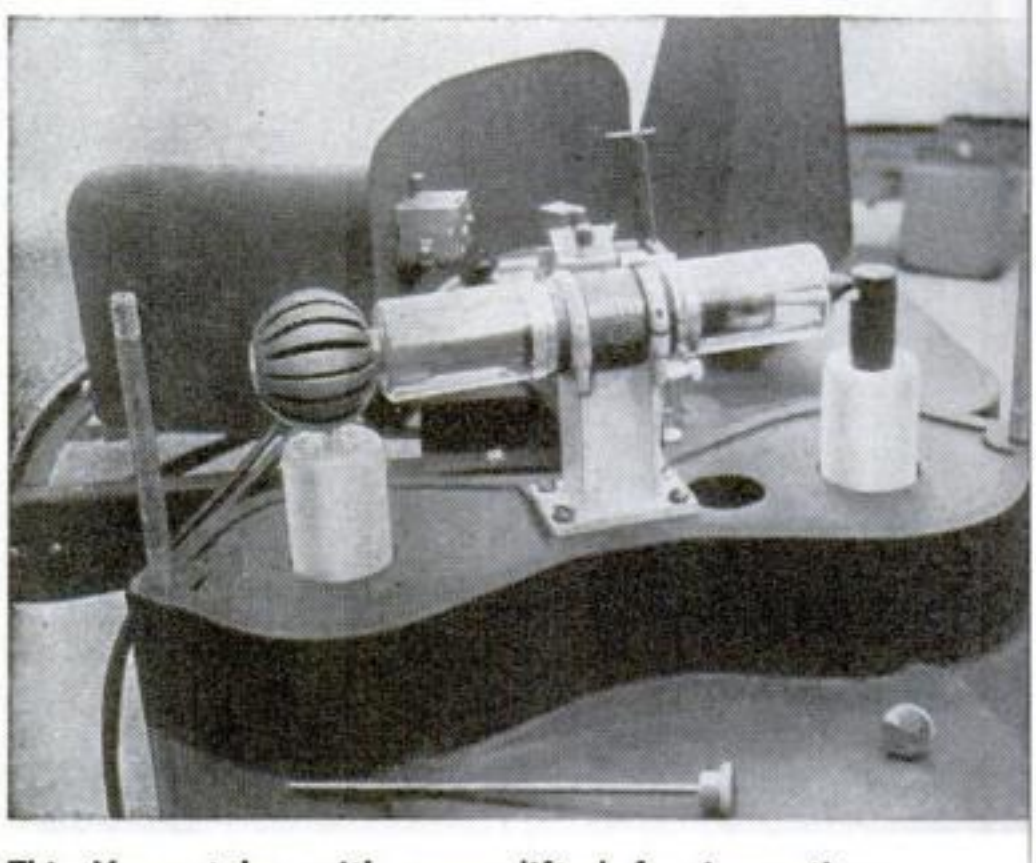
IMAGINE a chemical laboratory of the future: Gone are the "trains" of glassware, the test tubes, the liquids bubbling through test flasks. Instead, practically automatic electronic instruments pick up and record readings for the chief chemist. The walls are lined with automatic recorders from which he tears off teleprinted reports and telephones orders to a chemical mixing room Frequently his timely intervention saves a batch of alloy that otherwise would land in the scrap heap.

This does not mean that straight chemical tests are out of date; they will continue to be used for many purposes. But eagle-eyed physicists have been striving to outdo them. On X-ray diffraction they have pinned their greatest hopes. X-ray diffraction concentrates a "pencil" of X rays on the specimen. Rays bounce off in all directions. Formerly the record, a pattern of arcs, was inscribed on a band of film coiled within the outer wall of a drum-shaped camera. From this film record the expert could identify the various chemicals in the specimen and roughly estimate the amounts. Now the record appears on a moving-paper chart.

Probably the first major advance in years in X-ray diffraction has been the substitution of a Geiger counter for the camera. This device, more familiarly known as a means of registering cosmic rays, in its new function is known as the Geiger-Counter X-ray Spectrometer. It quickly analyzes boiler scale, paint pigments, precious and semiprecious gem stones, foreign deposits on valves and bearings, soils for agricultural use, cheese, asbestos, cellulose, cement, dry cells, rayon and rubber.

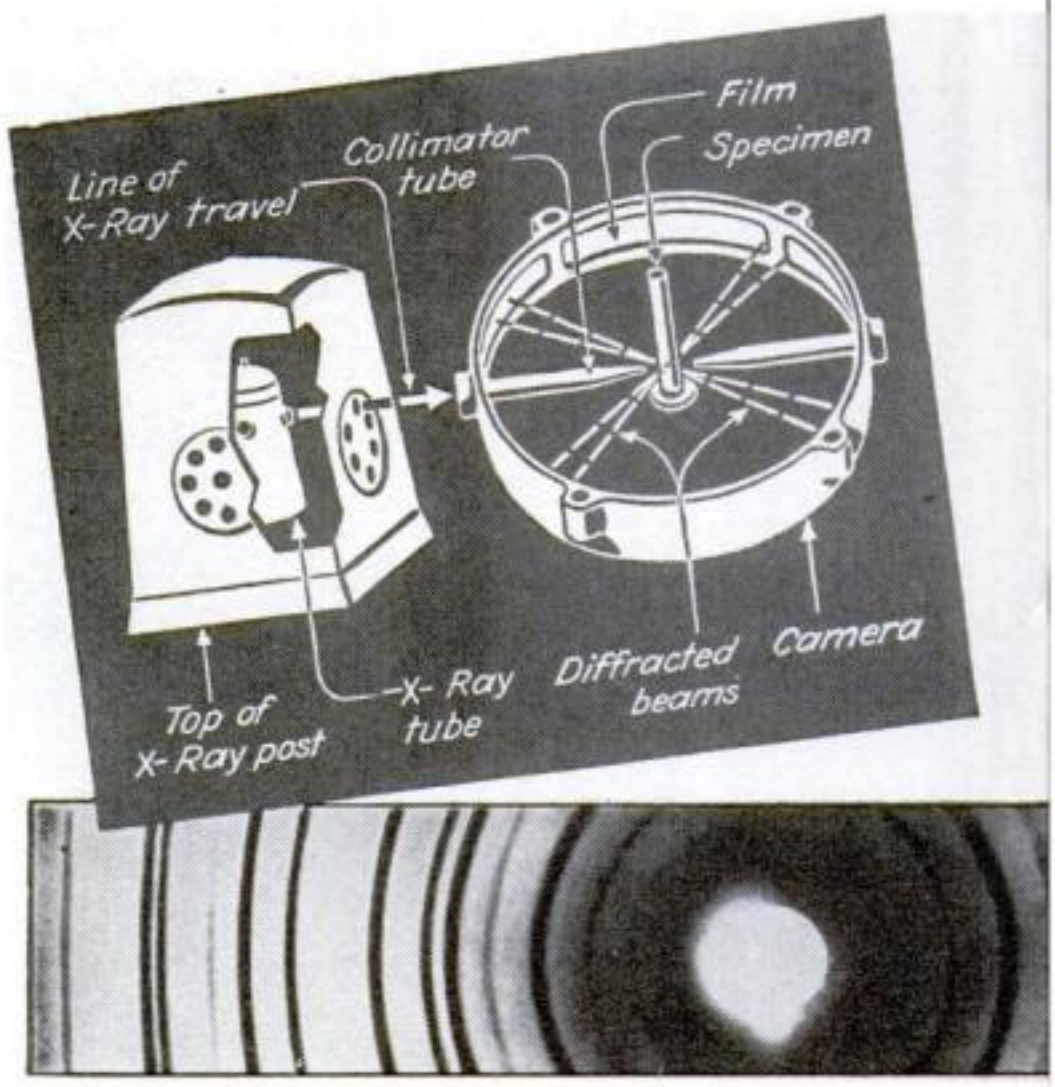
Equally interesting to an industrial chemist, analysis charts need not be sent to an academic laboratory for interpretation. Accurate to within one percent, they are often ready within 10 minutes. The X-ray Spectrometer also has been throwing new light upon how catalysts, the go-between agents of chemicals hard to join, may be "poisoned" and rejuvenated.

At present there is only one Geiger-Counter X-ray Spectrometer, at the New York City showroom of the North American Philips Co., Inc. Its sponsors hope soon to see hundreds in use.—ALDEN P. ARMAGNAC.



This X-ray tube, with cover lifted for inspection, was specially designed for use in the new electronic chemical analyzer. The principle dates back years to the first experiments with X-ray diffraction.

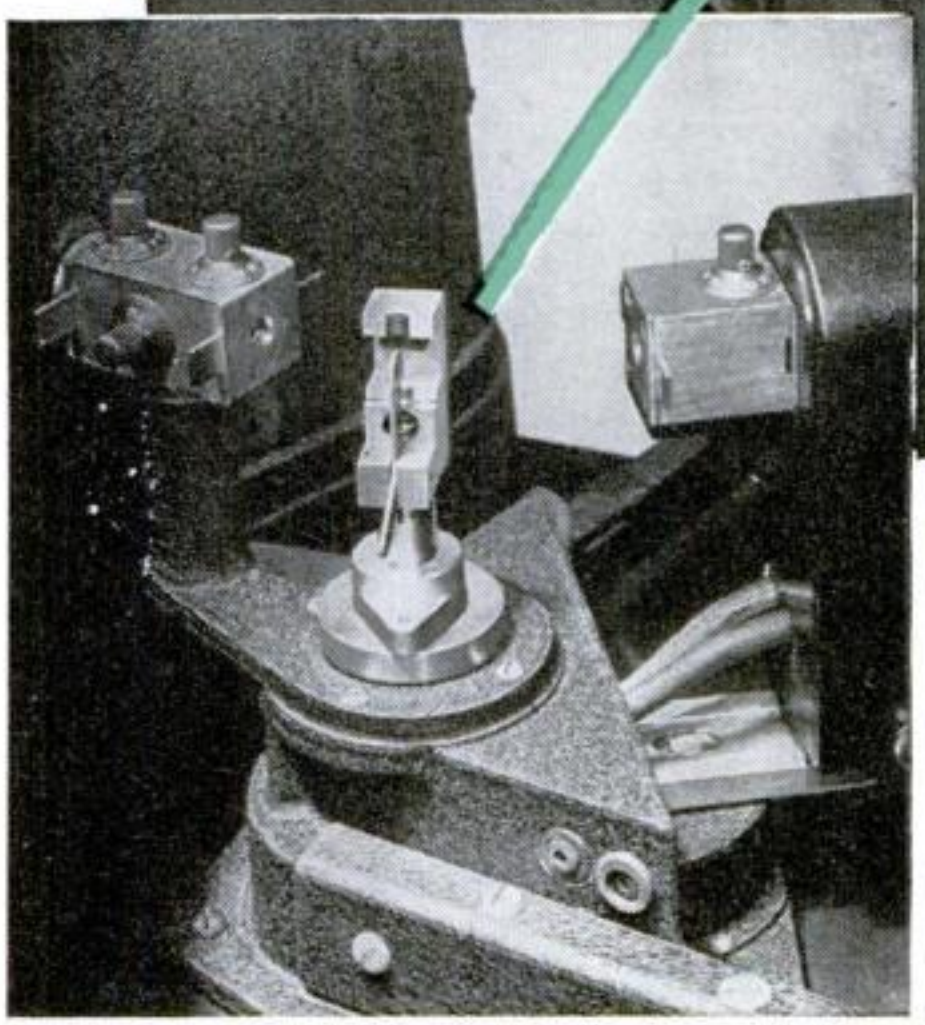
In earlier X-ray diffraction, rays led through a hole in a round camera (below) penetrated the crystal specimen at the center of it and rebounded to a film lining the wall of the camera. The film record (bottom of page) told experts what chemicals were present and roughly in what amounts. Darkest arcs in the pattern indicated greatest quantities.



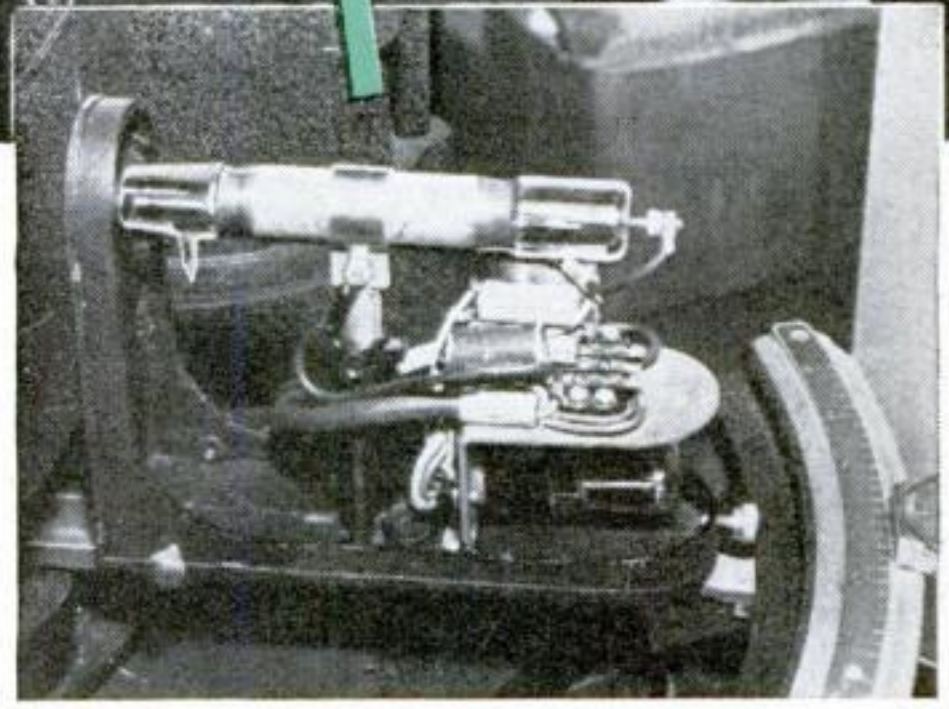



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Industrial engineers can quickly read the ups and downs of their products on the moving chart on which the Geiger-Counter X-ray Spectrometer records its chemical analyses.



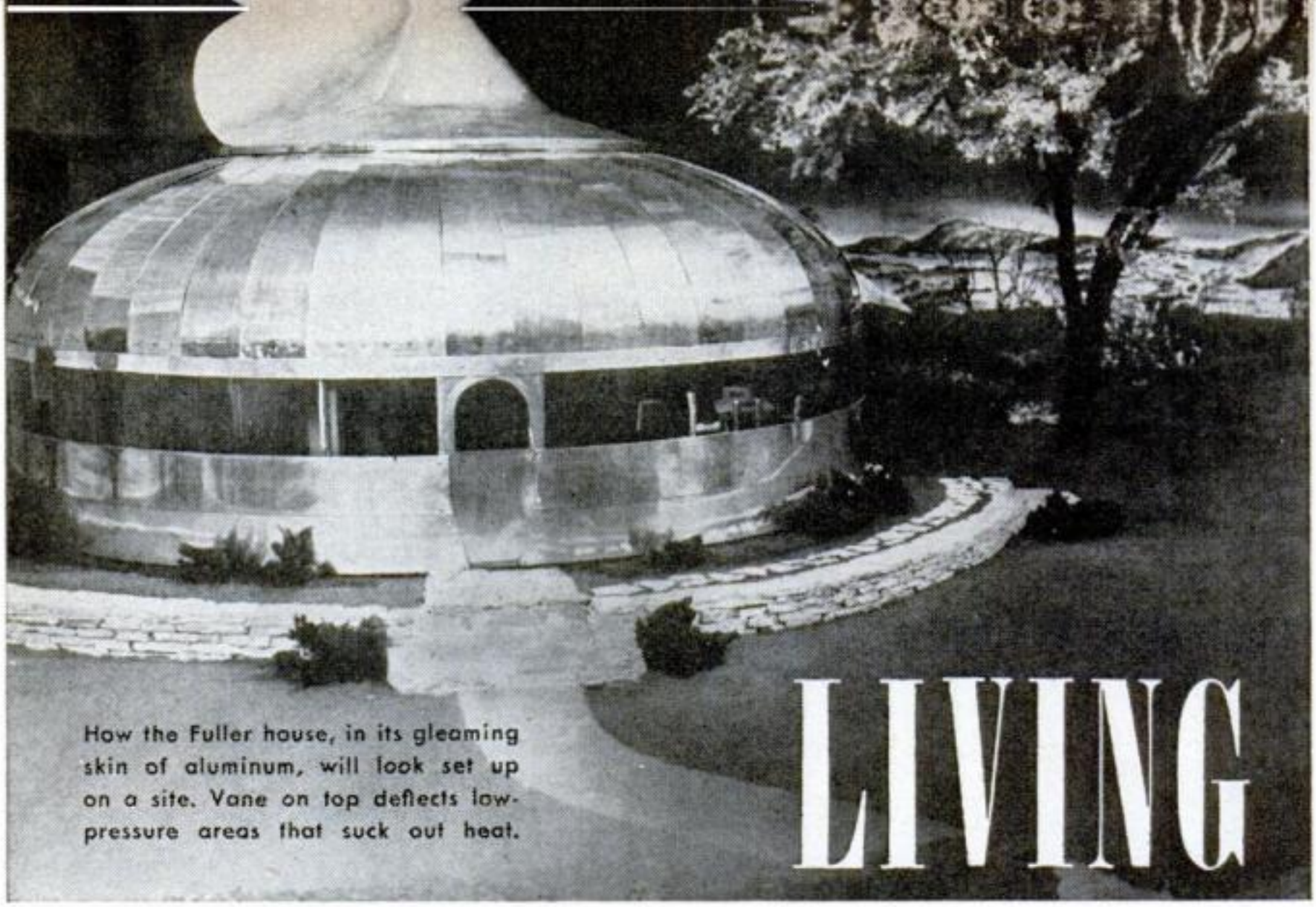
In the vertical mount in the center, resembling a microscope slide, a crystalline specimen will be inserted for analysis. The window at left emits X rays, which then are bounced by the specimen into the window of the Geiger counter at right.



The Geiger counter, essential to atomic medical research (pp. 91-95), becomes an industrial tool for the first time in the new chemical analyzer. It picks up X rays reflected from specimen, translates its electrical impulses onto moving chart.



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How the Fuller house, in its gleaming skin of aluminum, will look set up on a site. Vane on top deflects low-pressure areas that suck out heat.

# LIVING

FIFTY thousand $6,500 houses, looking like 36-foot dishpans bottom up, are scheduled for production next year in a Wichita aircraft factory. Engineered like an airplane, each will include a living-dining room, two bedrooms each with bath, and kitchen—complete with heating, plumbing, lighting, air conditioning and decoration. Beech Aircraft is to turn them out.

Engineer R. Buckminster Fuller has been rooting for such houses for 18 years. He designed them unlike any other dwellings, using the principles of suspension-bridge, not building, construction. Eight men can put up a Fuller house in two days—or take it down and re-erect as many times as you like. It will stand a 180-mile gale and five times its expected work load. Built of materials highly resistant to decay, weather and insects, it needs no paint and can be washed with a hose.

No whim, the hemispheric shape is the result of Fuller's efforts to evolve a durable shelter, requiring a minimum of upkeep, which would be pleasant, cheap—and much more efficient.

Cheapness meant mass production, meant light weight to permit continental distribution. The round shape, new materials, new design—all save weight. Only 13 percent longer than the walls of a conventional 25-foot square house, the 113-foot perimeter of the Fuller House encloses 54 percent more space. The shell is aluminum; skeleton, alloy steel; windows, plexiglas; floor, plywood locked with aluminum. Lucite, synthetic rubber, magnesium, nylon, fiberglas; all improve performance—and save pounds.

The walls and roof are hung from a central mast, like a tent. Three rings carry the load, the innermost suspended from the mast by a series of crisscrossed tension rods like the wire spokes of a bicycle wheel. The same device holds the outer rings, supports the floor, and anchors the bottom firmly to the ground. Aluminum skin covers the skeleton. Because the skeleton is stretched, the members can be made smaller; modern steel alloys have greater tensile than compression strength.

The shape saves heat. The average U. S. wind is 10 m.p.h. and every house has a low-pressure area to leeward which sucks out warm air through walls and windows. The Fuller's rounded skin minimizes drag; the revolving vane focuses the low-pressure area upward and away from the house. Gas, oil or electricity power the heating unit, located on the central mast. Cold air is pulled in beneath the floor, rises through the mast, is heated and expelled into the rooms, cools and sinks, then is sucked back to the center mast. Here the low-pressure area takes over, sucking the used air out through the roof vane.

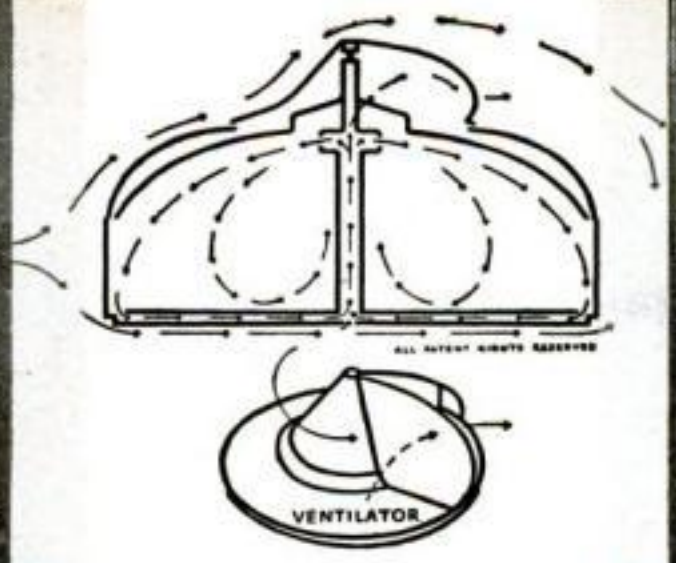
The aluminum sheets of the outer roof are laid with open expansion joints, permitting rain to run through onto the hollow ribs below, then down inside the roof to a gutter within the eaves.

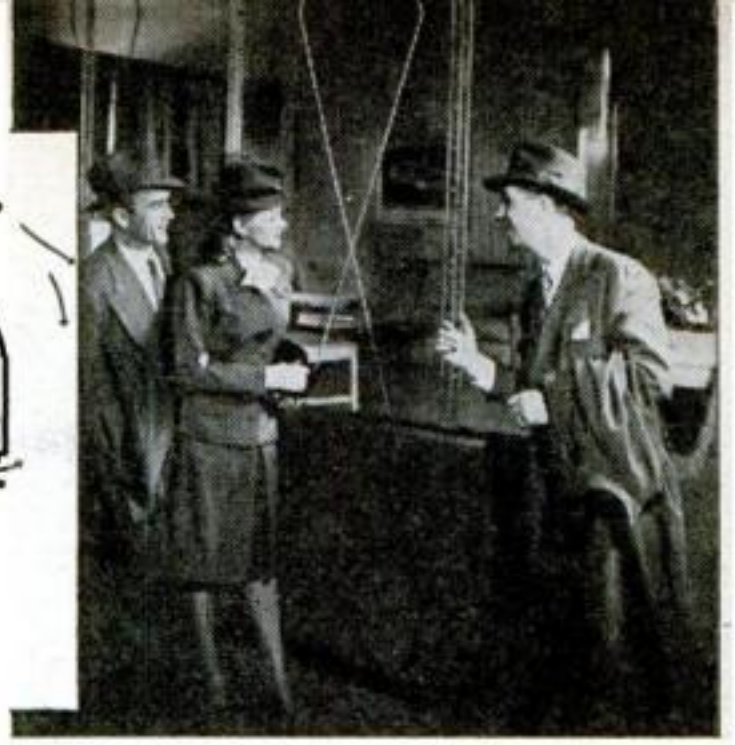
The whole house weighs just 6,000 pounds, compared to 90,000 pounds for a frame house of the same size without foundation. With 1,000 pounds of equipment the Fuller house can be shipped in a 16-foot steel cylinder, 4½ feet in diameter.



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House has airplane-type doors. A 75% saving in winter heat bill is forecast. In summer, aluminum outer shell reflects sun's heat.

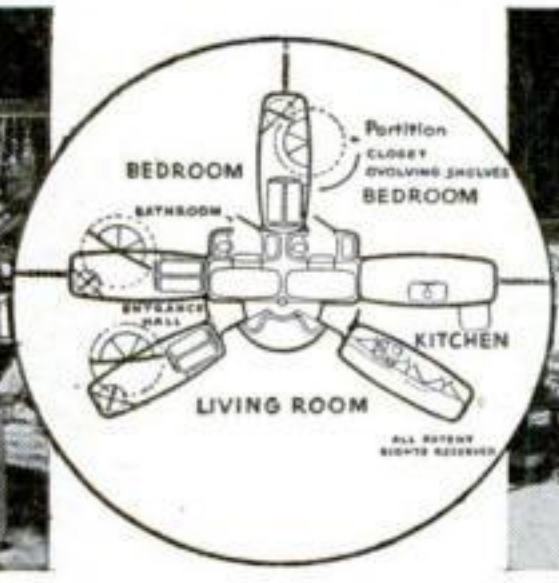
Air is circulated in fountain-like movement. Complete change takes six minutes, eliminating dust and germs.

Plexiglas windows encircle the house, are airtight and shatterproof. The crisscrossed tension rods hold up the floor, extend to ground anchoring.

# in CIRCLES

## Plane Makers to Roll Out Buckminster Fuller's Round House in '47



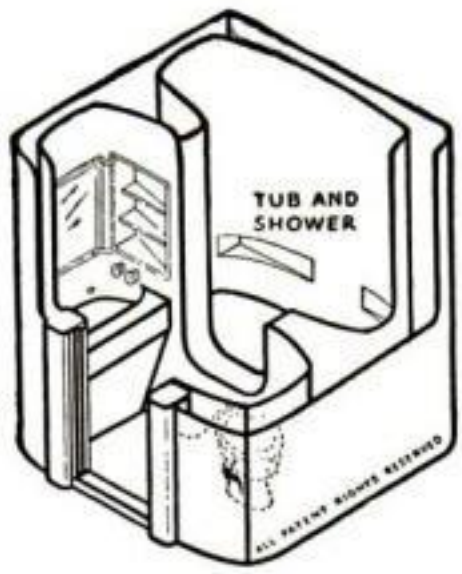




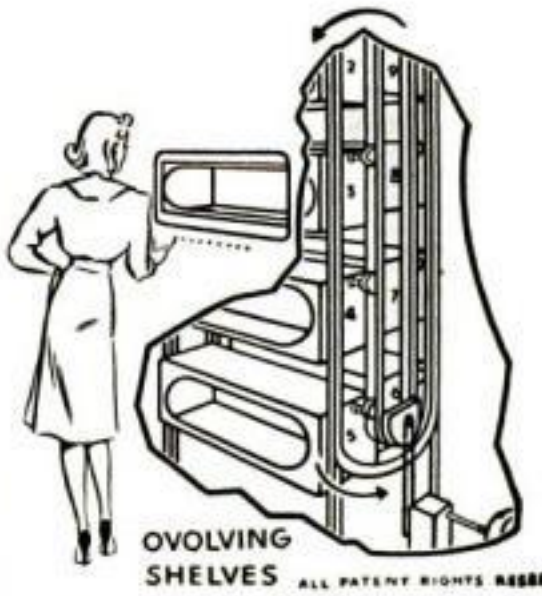

One of the two bedrooms, comparable in size to a room 14 x 15 ft. Wall panels are plywood and aluminum. Folding door is space saver.

Power, plumbing, ventilation ducts are grouped around central mast, other equipment in walls.

Living room has same amount of space as a room 21 x 16 ft. Wall below window has plastic-fabric covering. A pull-cord lowers it, exposing plastic screen.






Bathroom of aluminum and plastics has no cracks or corners to catch dirt. Washbowl will serve for baby's bath.

Closet doors revolve, swinging out semi-circular clothes and shoe racks. There also are compartments for handbags, suitcases, plexiglas-enclosed hat racks.

House has three units of electrically operated "ovolving" shelves, each with 27 cu. ft. of space, equal to two bureaus.



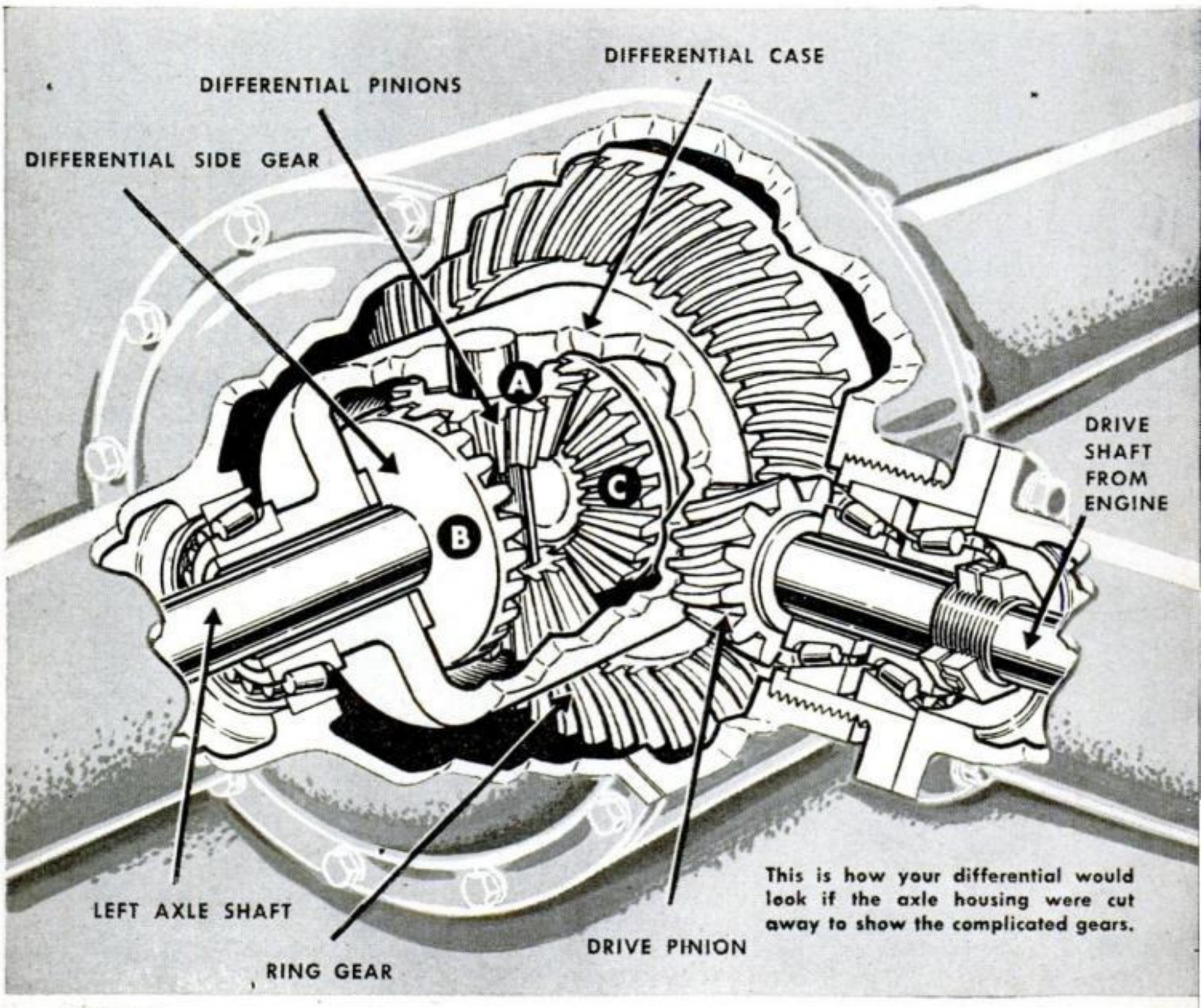
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Mechanics of LIVING

# How Your Car turns corners

IF YOUR car had to travel only in a straight line, it could be almost as simple as an oldtime wagon. A basket full of gears, shafts, pinions, levers, and other parts, front and back, could be discarded. A steering gear and a few rods could come off the front. But the rear has some complicated machinery for going around corners. On a turn, one rear wheel needs more speed. It has farther to travel—like the man on the outside file of a marching column of men. The other wheel needs less speed; it has to slow down on a turn—like the man on the inside of a marching column.

So a unit called the differential stands between the two halves of the rear axle and takes charge of the engine speed. When your car is traveling on a straight road, the differential divides the engine speed into two equal parts—one to each rear wheel. When your car turns a corner, the differential divides the engine speed into two unequal parts. The differential takes some speed away from the wheel on the inside of the turn, and gives it to the wheel on the outside. Follow the drawings on the next page and see how the differential works—and how your car turns corners.




This is how your differential would look if the axle housing were cut away to show the complicated gears.



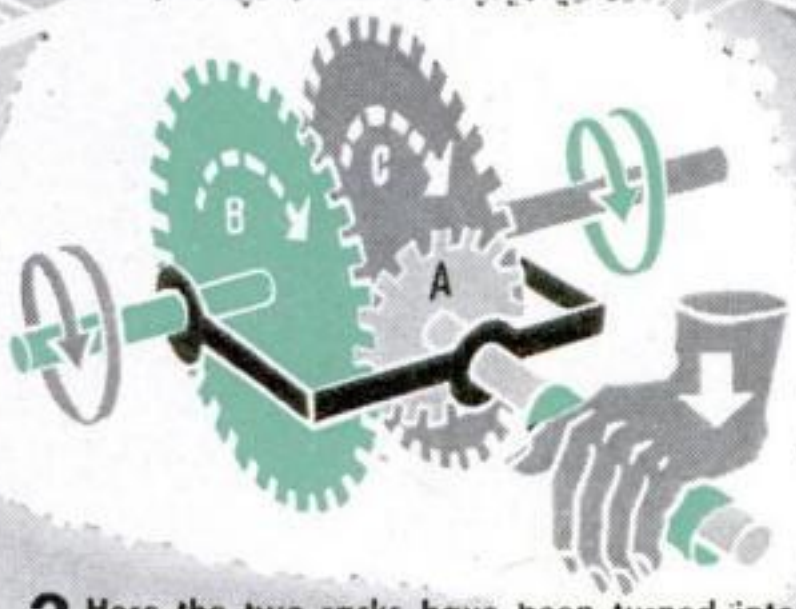
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**1** Main parts of a differential work like the pinion A mounted between two racks B and C. All three parts are free to move. As hand pushes down, pinion won't revolve, but pulls racks down with it.



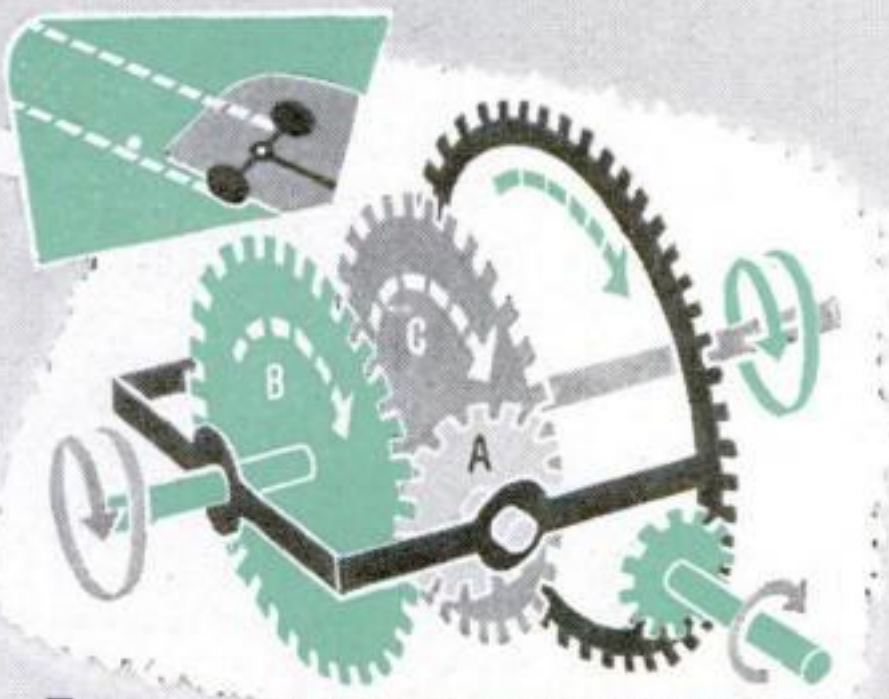

**2** When the hand holds back slightly on rack B and the pinion is pushed down, the free rack C will be depressed by the pinion. But the rack B that's held will start the pinion rotating, moving rack C faster.




**3** Here the two racks have been turned into round gears, B and C, more like the actual differential. Pinion is still mounted between the gears, and acts the same way. As the hand pushes on pinion A, it won't revolve but pulls both gears down and around.




**4** Slow down one round gear, the same way the hand held back on rack B in 2. Now when the pinion is pushed down, it starts to rotate. The pinion is pulling the free gear C around, but the rotation gives that gear a boost, and slows down gear B.

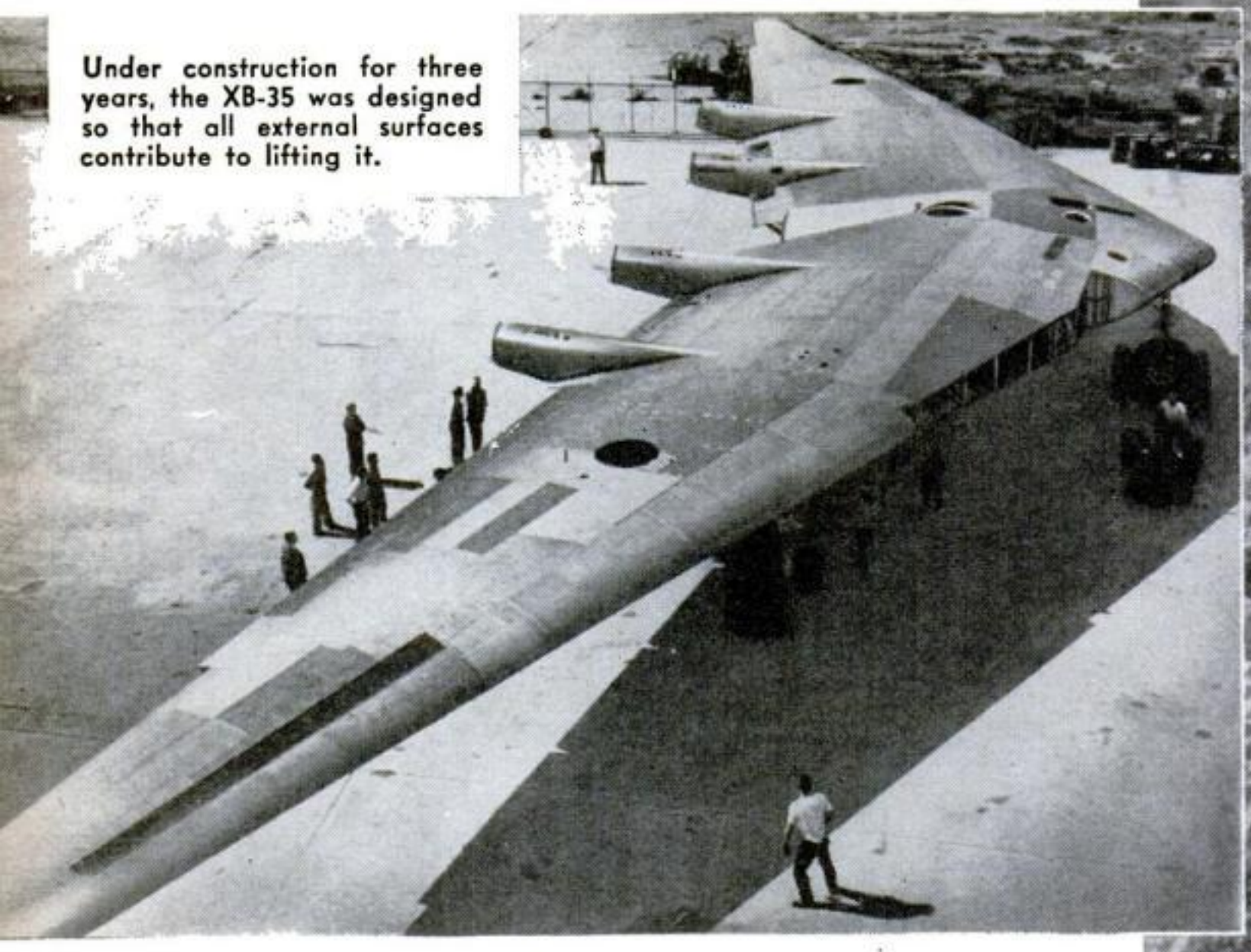



**5** Compare this combination of gears with drawing to the left. Instead of a hand, engine power is pushing pinion A down. When your car is going straight ahead, the differential pinions are pulling both gears B and C around, driving the rear wheels.

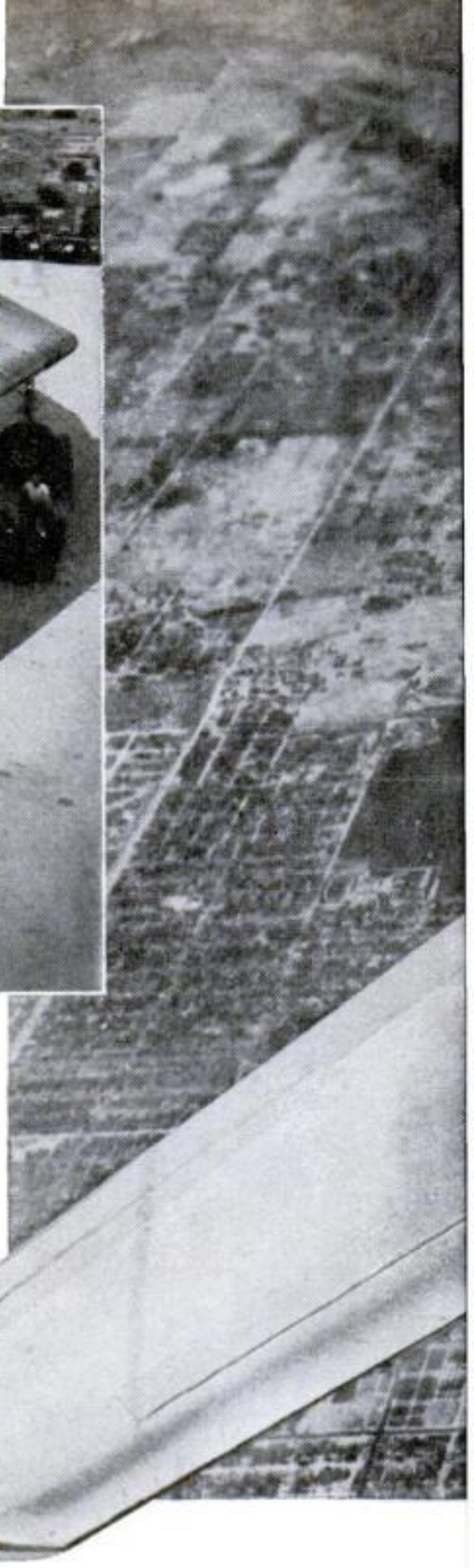



**6** When making a right-hand turn, the tire on the right wheel pivots and slows down. This slows the round gear B and affects the pinion. It starts to rotate. The rotation gives the gear C a boost and retards gear B. That's how the rear turns corners.

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Under construction for three years, the XB-35 was designed so that all external surfaces contribute to lifting it.



# 100-Ton flying wing

## *OUTSTRIPS B-29*

By LEON SHLOSS and
ANDREW R. BOONE

EFFORTS to make tailless aircraft practical began the year before Orville Wright was born. At least 40 pioneers, of nearly as many nationalities, have contributed to the science. Now an American, John K. Northrop, has done it with the Army's XB-35 bomber.

This plane, weighing 89,000 pounds empty, under overload conditions will lift 60 tons of bombs, gas, crew and cargo. The 209,000-pound gross weight is 78,000 pounds more than that of the Boeing B-29 Superfortress. The boomerang-shaped wing is 4,000 square feet in area, more than double the B-29's; hence the great lifting power. Most parasite drag went out with the fuselage, and higher speed came in. The speed figure is undisclosed, but it is known that the plane is expected to outfly the fastest conventional fighters, which approach 500 m.p.h. Four Pratt & Whitney 3,000-hp. engines turn Hamilton Standard coaxial pusher propellers. Fifteen Flying Wings have been ordered, with jet power in prospect for future models. The plane will be shown about the time this story appears. First flight depends on progress of pilots who are preparing to fly the radical giant. Complicating the problem was the death of the outstanding Flying Wing test pilot, and the short, 5,700-foot runway from which the first take-off must be made.

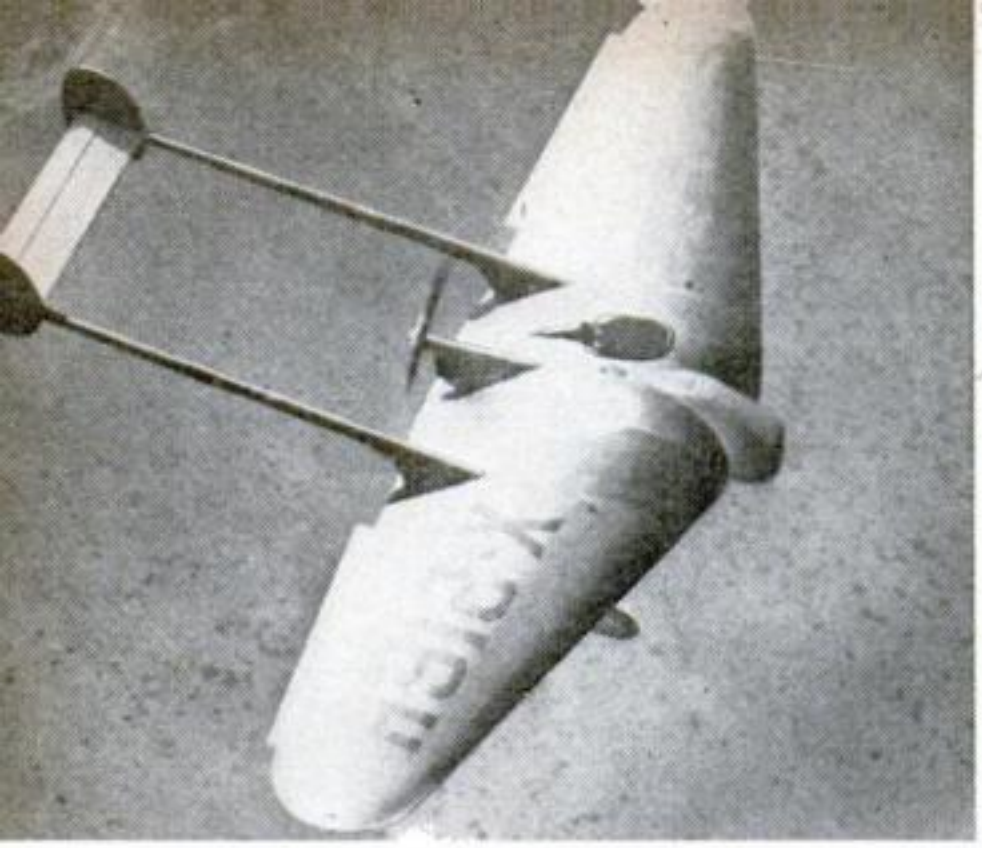
Built by the Northrop Aircraft Co., at



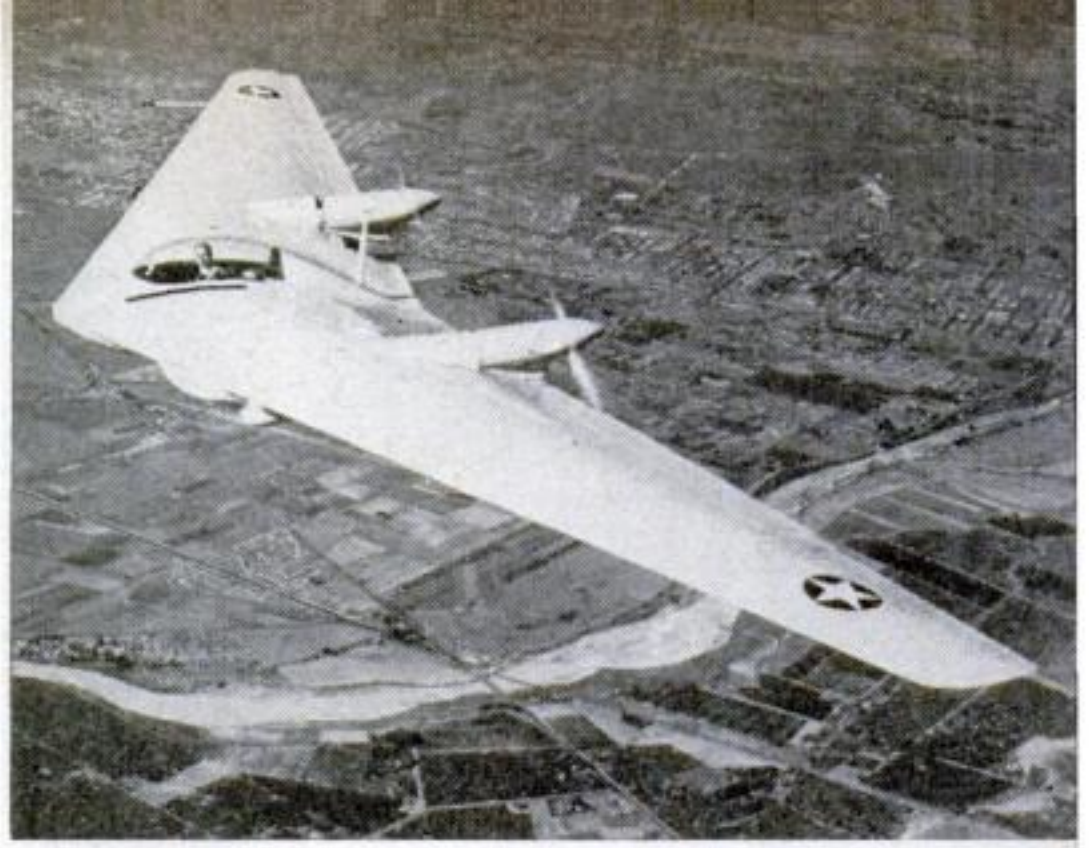
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Artist's conception (above) shows XB-35 in flight over Los Angeles. To the right you see open section of wing that may hold cargo.

Wing slots on the N9M, 60-foot scale-model forerunner of the XB-35, were added to increase stability at low flying speeds. Control is achieved by slots, wing rudder and tabs, plus Northrop "elevons," which function as combined ailerons and elevators.



This pseudo Flying Wing of 1929, with 30-ft., 6-in. wing span, contributed a lot of data to the plans of the XB-35.



The N9M was the last of four 60-foot scale models used to predetermine the flight characteristics of the XB-35.

Inglewood, Calif., of a war-developed aluminum alloy—75-S—the XB-35 has a theoretical range of 10,000 miles—from New Orleans to Singapore. Everything is carried within the wings including the engines, excepting gun turrets and a pilot-canopy bubble. All external surfaces contribute to lift. "Elevons" installed in the trailing wing edges combine the functions of elevators and ailerons. Landing flaps, trim flaps and rudders are also in the trailing edges. To move the controls the pilot uses a so-called "feel" system coupled to a full hydraulic boost system. The "feel" applies varying pneumatic forces to the control system at different speeds to hold control movements within safety limits.

Further control is achieved by automatically operated long wing slots paralleling the leading wing edge. These slots assure continued smooth laminar airflow at near-stalling speeds.

Militarily, the XB-35 enjoys the unprecedented advantage of comprehensive fire power aft, thus removing the airplane's greatest combat vulnerability—the hard-to-defend tail. It also presents a smaller target—and can carry the atom bomb, a chore performed heretofore only by the B-29.

Other advantages listed by Northrop will apply to cargo as well as fighting editions: Low drag, high lift allowing transport of any weight faster, farther and cheaper; simple construction; more even distribution of weight; spanwise compartments that accommodate rectangular packing cases more neatly and can be loaded or unloaded more quickly and easily than tubular holds.

Several foreign designers have built tailless airplanes that flew well, but they encountered engineering obstacles, which Northrop presumably has whipped. There is a transition phase in take-off and landing during which a tailless plane may be hard to control. The biggest engineering hurdle, however, has been the tendency of tailless planes to flat-spin, followed by inability to nose down in order to recover. Until the wing was made thick enough to enclose engines, crew, payload—everything, in fact—there was little aerodynamic justification for such a plane. And a wing that thick meant a plane far larger than could be economically justified. Military need in World War II for mammoth planes, and the current postwar demand for volume and global air transport, brought about a wing large enough to increase chord (depth of wing) to the point where the nose *will* go down.

Another shortcoming was the inability of tailless planes to glide to safety in case of engine failure. This was ironed out along with the original problem when, in the '30s, aircraft engines became so dependable that failures became virtually unknown.

A great obstacle to Flying Wing development has been the timidity of industry to delve into types untraditional and therefore hard to sell. It has usually been the unconservative boss of the small shop who has waded into the lists of radical design. That describes 50-year-old Jack Northrop, who has been designing radical airplanes for 30 years. His first model of the Flying Wing, with a wing span of 30 feet, six inches, had twin booms and a tail, and so was not a true Flying Wing. The first true Wing was flown in 1940, utilizing drooped wing-tip controllers, which Northrop proved successful by experimentation with paper models. This plane was built of wood, easily adaptable to changes in design. General H. H. Arnold, later head of the Army Air Forces, saw this plane fly and ordered developmental work begun on a huge Flying Wing bomber from which grew the XB-35.



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# REALLY doubling in BRASS

Brad Gowans uses slide and valve simultaneously on his new "valide" trombone.

Close-up of valve assembly (below) shows thumb holding key that locks first valve.



## This Young Man's Horn Does Two Horns' Work

BRAD Gowans cites the musical passage above as one that can be played only on one trombone—the Valide, combination valve and slide instrument that he invented and built. Known to millions as an outstanding "hot" musician, Gowans is not widely renowned for the fine machinist he also is.

Since 1922, Gowans has played the slide trombone, clarinet, cornet, saxophone, drums, piano, ballad horn and valve trombone with 27 groups, including The Original Dixieland Jazz Band. He is now playing the Valide in Eddie Condon's band. On the Valide 28 notes can be played in one position without changing the embouchure (position of the mouth against the mouthpiece) as against seven on any other trombone; it can be used as a slide trombone in seven keys by locking down the valves in different combinations, as a valve trombone in four keys by locking the slide in one of its four positions, as a valide by using both methods at once or one in conjunction with the other. The thumb of the left hand operates the valve lock to add the fifth, sixth and seventh positions to the four-position slide. The middle finger of the left hand holds the slide and tunes the valves when the right hand is being used on the valves. The right hand operates both valves and slide. Where fast changes are involved the thumb and little finger control the slide while the second, third and fourth fingers work the valves.

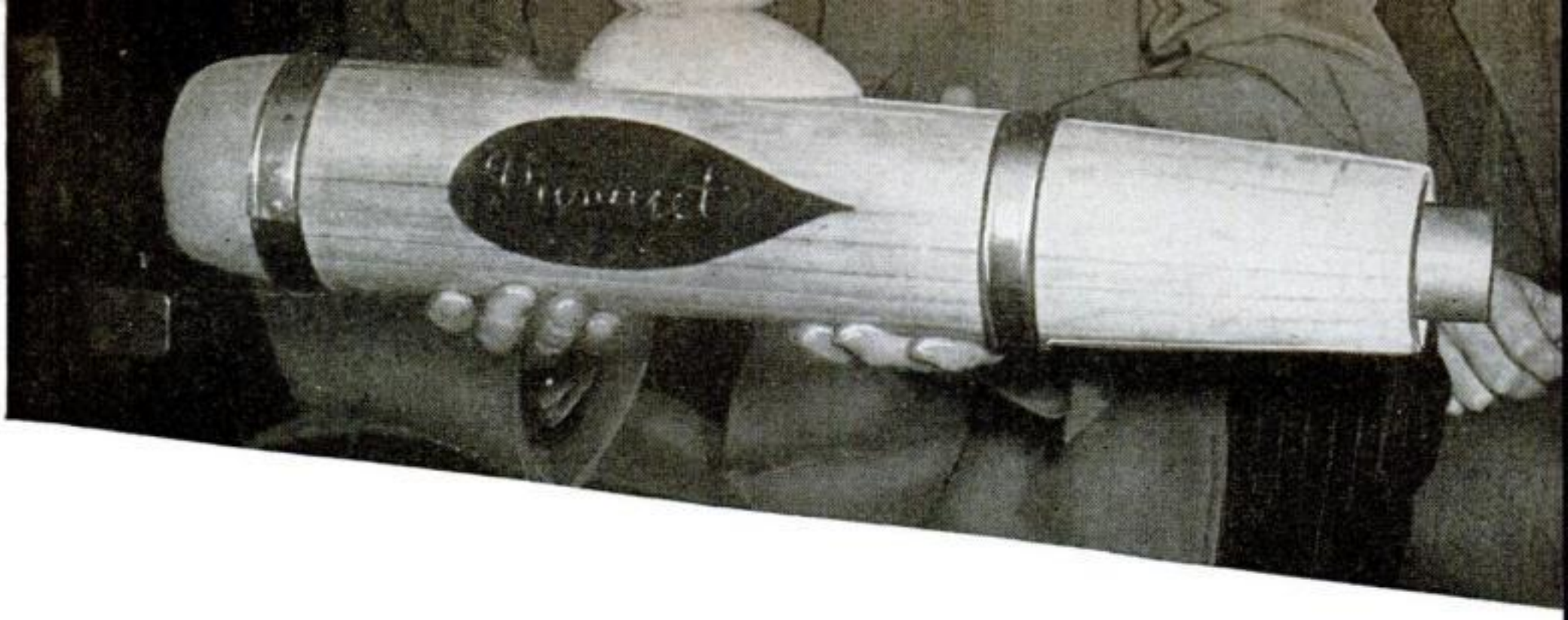
Other advantages: Valve assembly is moved up close to mouthpiece, relieving player's arms of much weight; short slide avoids danger of smashing slide into some obstacle; many arpeggios impossible of execution on slide trombone can be played; chromatic passages can be played faster; glissando is easier of execution; embouchure is not disturbed when slide is fully extended.

Gowans will not market the instrument, at least not until he finishes a new contract recording for Victor with his own band.

This Young Man (Really) With A Horn also recently perfected a realistic parlor baseball game after 25 years' work. Right now he is installing a 91-cubic-inch, 8-cylinder racing engine in a British Standard Swallow. After he finishes playing with Condon at 4 a.m., that is.



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# BABY V-1 Flies for Fun

## Tiny jet built to power models drives toy car 150 miles an hour

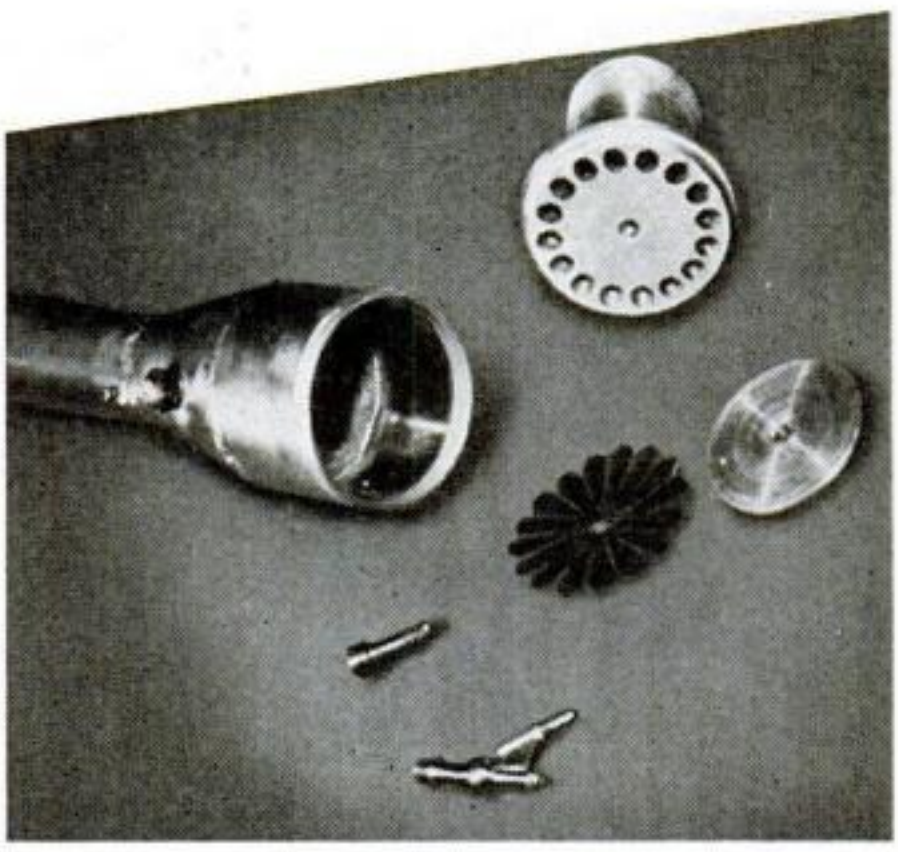
THE same kind of a pulse-jet engine that poured winged bombs—V-1s—on England in 1944 has now been reproduced in miniature to power model airplanes, automobiles and boats. The inventors, William L. Tenney and Charles Marks of Minneapolis, have shrunk the Nazi engine to toy size. For its measurements, it probably is the most powerful package of energy ever produced. It will drive a miniature automobile, for example, 150 miles an hour.

The 12-foot Nazi jet produced a "thrust" of 600 pounds. The 21-inch baby jet supplies a thrust of three pounds when not moving, more than that when movement rams air through the spring shutters in its nose. Tenney states that his company, Aeromarine, can go the Nazis one better by producing from 600 to 800 pounds of thrust with an engine less than three feet long and 16 inches in diameter. The V-1 power unit was 22 inches in diameter.

In larger sizes, the inventor believes, this "Dyna-jet" could be used to drive full-scale airplanes, racing cars and boats. He foresees its use as a "life preserver of the air," supplying power for air transports in case of engine failure. It could also, he says, afford extra bursts of speed for fighter planes and for the take-off of heavy planes.

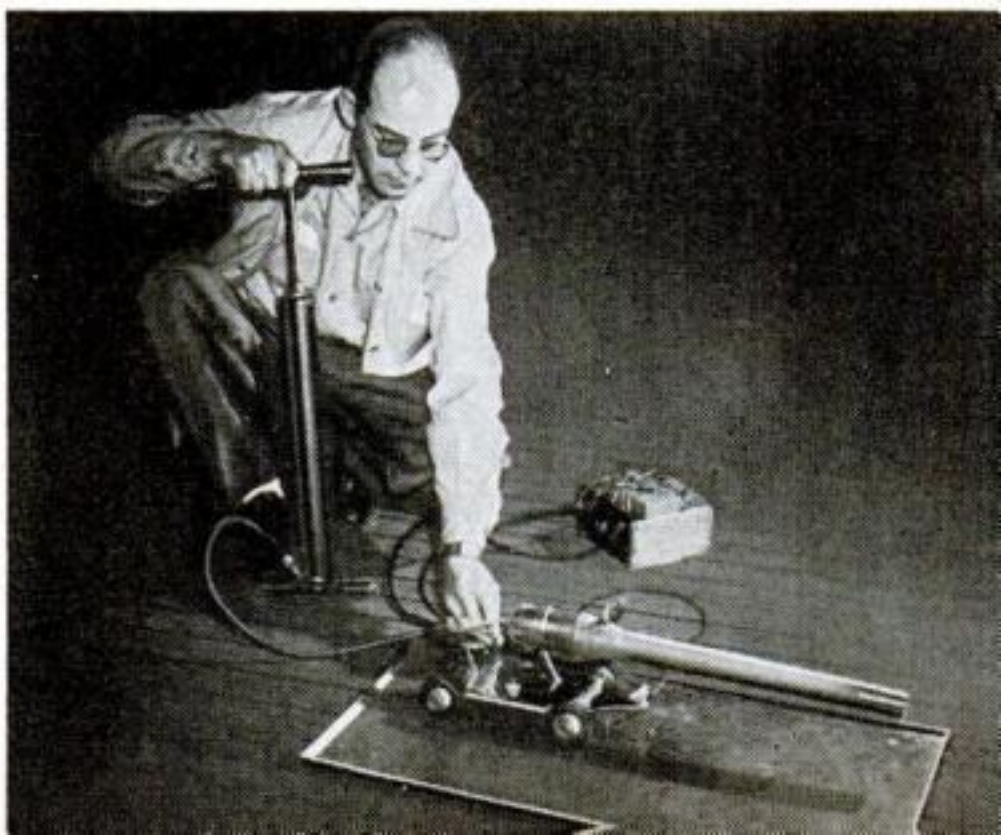
Like the original jet on the robomb, the "Dyna-jet" is economical of parts. And only one of them—the shutters that alternately receive and shut off the entrance of air in the combustion chamber—moves. The entire assembly weighs only a pound. Its fuel is gasoline, kerosene or stove oil.

Like the big jet, it uses compressed air,



The "Dyna-jet" tube holds only six parts, made of stainless and spring steels and aluminum.

A bicycle pump supplies the tiny jet, mounted on a toy car, with compressed air for starting.



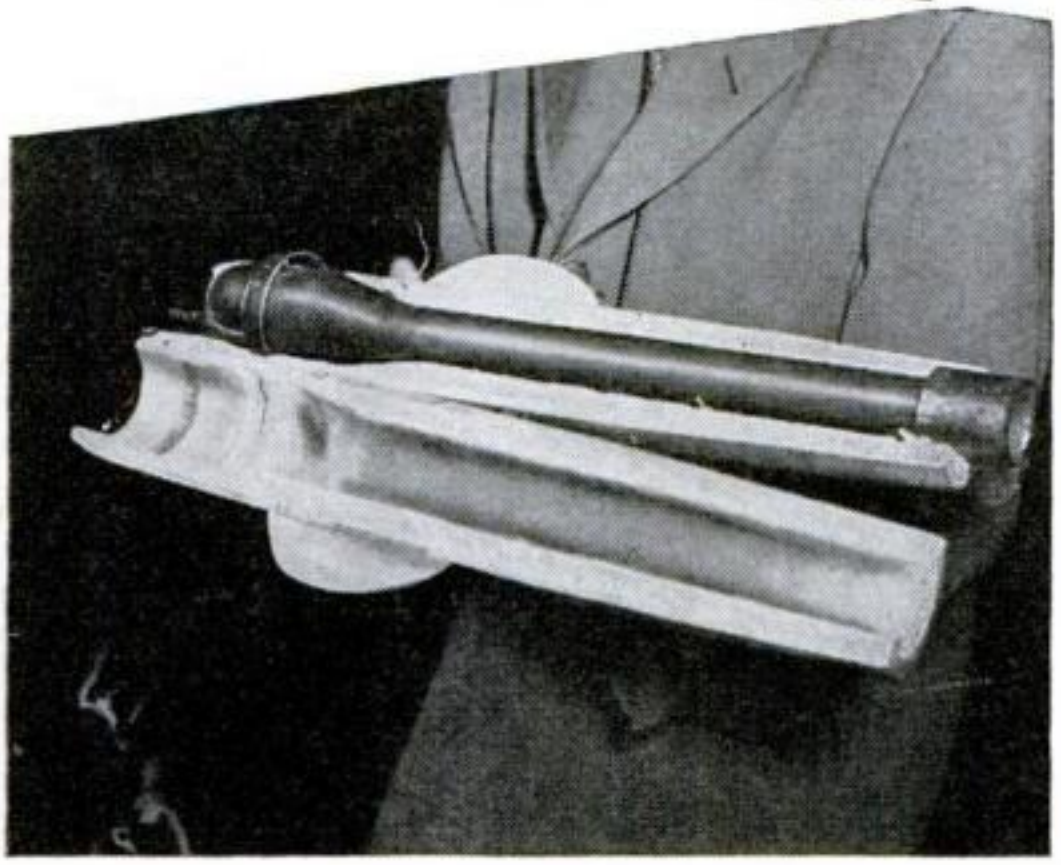


The baby jet engine is simple, light, powerful —and can be held safely. A flame a few inches long does issue from the thrust pipe but beyond the flame's tip the heat is dissipated rapidly.

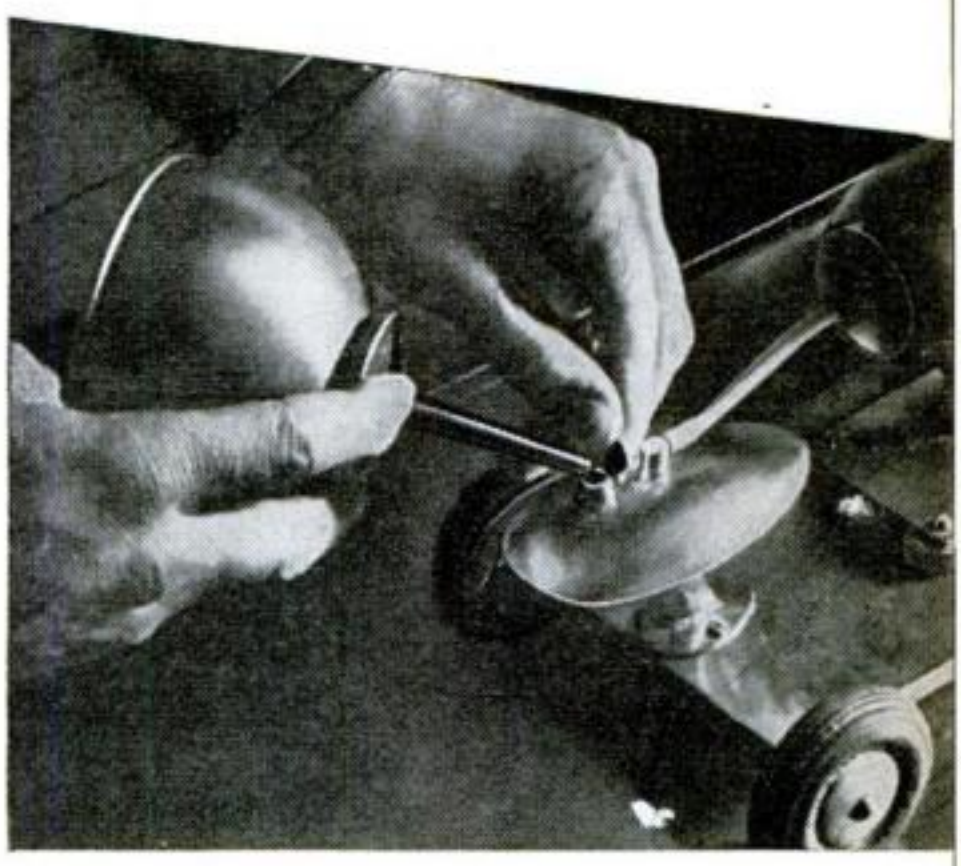
but for a different reason. The robomb contained two cylindrical bottles of compressed air to drive three gyroscopes that governed its flight. The "Dyna-jet" uses compressed air to provide a combustible mixture in the firing chamber to start the engine. Both jet engines use a spark plug for ignition.

There is another marked difference between the two engines. The robomb's engine pulsed at a rate of about 45 times a second. The baby jet pulses up to 250 times a second.

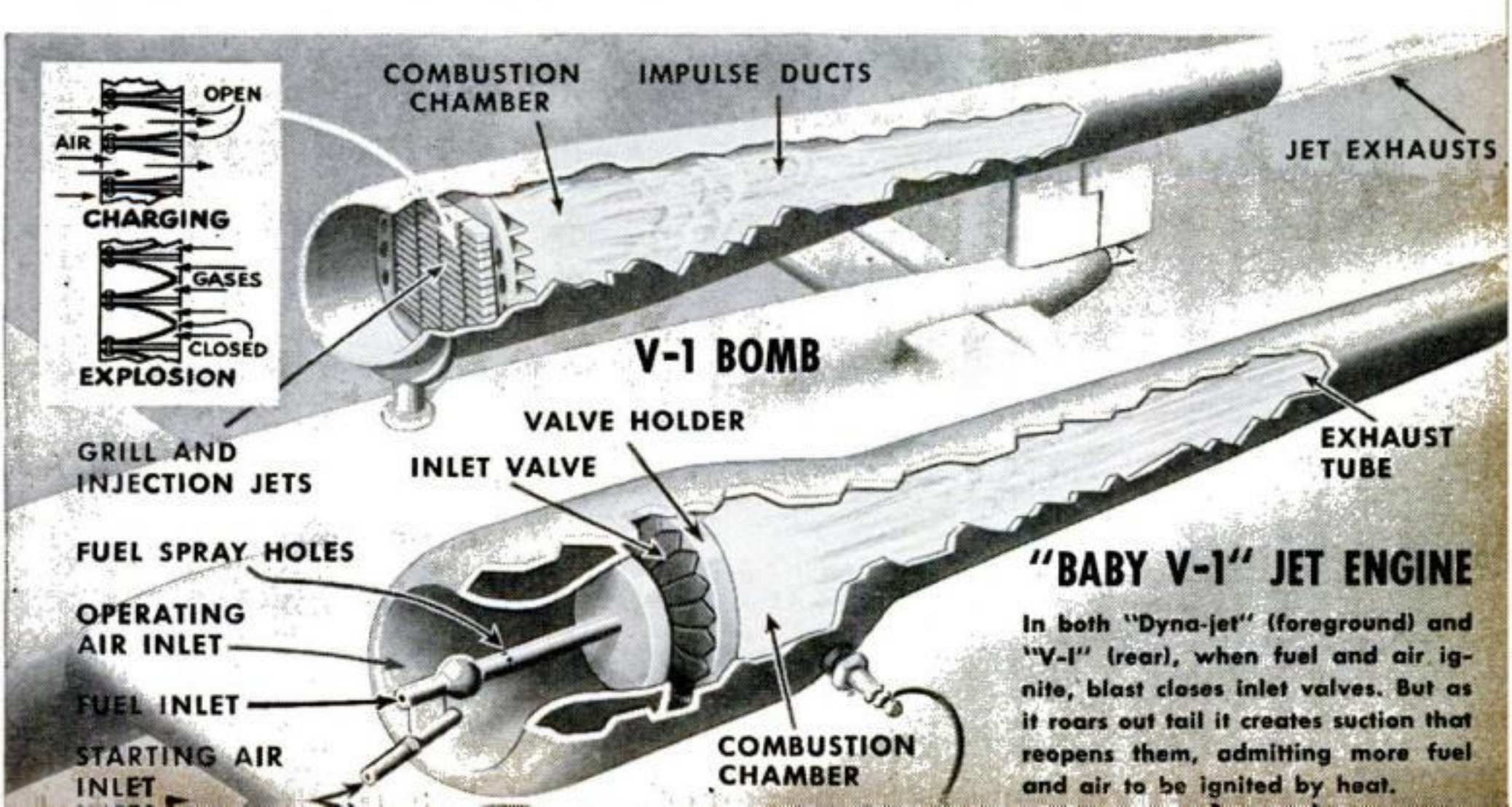
It was test flown in Dayton, Ohio, in March, but prior to that had driven miniature racing cars and boats.



Inventors Tenney and Marks confounded their critics, who predicted the jet engine would burn fingers and ignite model planes and boats, by wrapping it in balsa wood.



The "Dyna-jet" consumes fuel, from a household oil can, at the rate of two to three ounces a minute; operates from 12 to 15 seconds on it.




## "BABY V-1" JET ENGINE

In both "Dyna-jet" (foreground) and "V-1" (rear), when fuel and air ignite, blast closes inlet valves. But as it roars out tail it creates suction that reopens them, admitting more fuel and air to be ignited by heat.



TAXI SERVICE



VACATION TRAVEL



CROP DUSTING

FOR SUCH VARIED JOBS AS THESE

# Heli-taxis are here

By DEVON FRANCIS*

A MAN wrote to the Bell Aircraft Corp., Buffalo, N. Y., helicopter manufacturers, the other day and inquired, please could he buy a helicopter to go on a hunting expedition to Africa and wound an elephant? He didn't want to *kill* an elephant, he just wanted to wound it with rifle fire. He had heard that dying elephants all plodded off to a secret place to expire. In his helicopter he would follow the wounded elephant and turn up a fortune in ivory.

Another man asked if he could buy a helicopter, put an orchestra in it, and have it hover over the floor of his dance hall.

An undertaker wanted a Sikorsky helicopter to waft the mortal remains of his customers to their final resting place.

The manufacturers did not smile charitably behind their palms. Helicopters could do all those things. Of all the transportation vehicles engineered since the beginning of time, the helicopter is the most versatile.

And commercial helicopters are here. Deliveries will start next month. All that a person needs to buy one is enough money and a priority from a manufacturer.

Today's American helicopters were born just before the war and refined by use in the Burma jungle and on China's high plateaus. They flew in weather that grounded every other kind of aircraft. From boats standing off Pacific islands, they toted repair parts for Superfortresses to new landing strips. They plucked mariners from ocean swells. The crew of one helicopter, cruising over Alaska's wastelands, shot one of several wolves that had cornered a caribou.

In the next few months helicopters will be cruising over cities and towns and open country on dozens of kinds of errands. They will be used for short-range travel by business executives, for patrolling pipe lines, and even for taxis. Crop-dusting by helicopter will be commonplace. Hundreds of heli-

*Associate Editor, PSM, and author of "The Story of the Helicopter," published this month by Coward-McCann, $3.

*Drawings by T. MADAWICK*



SIDE-BY-SIDE INTERMESHING



TORQUE CORRECTION BY TAIL ROTOR



Sikorsky 4-place transport has top speed of 103 m.p.h. at sea level; will cruise 150 miles.



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INTERURBAN TRANSPORT



EXECUTIVE TRAVEL



COMMERCIAL FISH SPOTTING

## HELICOPTERS ARE IDEAL

# Manufacturers Are Forging Ahead with Machines that Stand Still in the Air.



Dr. Igor Sikorsky, dean of U. S. helicopter makers, converses with PSM's Devon Francis.

copters will soon be produced, but *they are not yet vehicles for private customers.*

Helicopters for commercial uses will precede those for private use for several reasons. They are still too expensive to buy and maintain, they are still comparatively inefficient (they won't go very far on a gallon of gas), they are still hard to fly; and, finally, the manufacturers don't want their product to fall into "unsympathetic" hands.

The manufacturers know that their product, potentially, can be sold in the millions to the public. If it is carelessly used and serviced at this stage of the game—if helicopters are involved in some bad accidents—the future market may be badly affected. If, on the other hand, hundreds or thousands of helicopters are proved out by hand-picked customers, tomorrow's market will be gratifying. Those hand-picked customers will be business houses and government agencies.

Helicopters are expensive, first, because they are being made in small quantities. Only mass production brings unit savings. Bell, for instance, will produce only 500 two-passenger machines as a beginning. These have been sold in advance. Helicopters are expensive, second, because the manufacturers are writing off at least part of their research and engineering costs on the first batches they turn out. They are expensive, finally, because as yet they are too complicated mechanically. One of the reasons for this complexity is troublesome torque, the tendency of the helicopter to twist in a direction opposite to that in which the blades whirl when power is applied.

Laymen insist on comparing helicopters



COAXIAL



Bell 2-place helicopter, with cruising speed of 80 m.p.h., carries more than normal load of one-fourth gross weight.

JET-PROPELLED





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BORDER PATROL



AIR-SEA RESCUE



PACKAGE DELIVERY

## FOR SUCH VARIED JOBS AS THESE

to airplanes and automobiles. A two-seated helicopter requires almost three times the power of a two-seated small airplane and is 20 miles an hour slower. The power required to run a two-seated helicopter would drive an eight-ton truck. But such contrasts make the helicopter people sore.

They say, first of all, that a helicopter cruises on half or less of its horsepower. It is highly powered to permit straight up-and-down flight. They say that neither an automobile nor an airplane will do what a helicopter will do. That is certainly true.

They say a small helicopter will use no more fuel than an automobile if each travels 80 miles an hour. That is also true.

They say an 80-mile-an-hour helicopter is far faster than an automobile and faster door-to-door than a 200-mile-an-hour airplane for distances up to perhaps 300 miles. That is true—if the helicopter can take off from the middle of town and land in the middle of the town it is going to while an airplane pilot is getting to and from airports.

They say that whereas an automobile must wind around tortuous curves and stop for red lights, a helicopter travels in a straight line at a constant speed. That is true. They say, too, that helicopters can fly in weather that immobilizes airplane and automobile travel. And that is true.

But they do not emphasize that the things are hard to fly. A helicopter has four controls, against three in an airplane. It demands strict attention. Yet the helicopter people say any normal person can be taught the rudiments of helicopter flying in eight hours of instruction. And helicopters are going to be easier to fly. A few of them are being equipped with a brand new gadget, a governor to draw from the engine the exact amount of power required by the pitch of the rotor blades. This has previously been the pilot's tricky problem. Of course, there is a catch—the governor costs no less than $800. But other simplifications will follow, just as clash-free gears and four-wheel brakes came to the automobile.

For six weeks, winter before last, Floyd W. Carlson, chief helicopter test pilot for the Bell company, flew a helicopter home every night and to work every morning. He landed in his front yard and left the machine parked out in the weather. He didn't miss a day despite sleet, rain and snow. That seemed to dispose of the theory that under icing conditions a man who took a helicopter aloft was a candidate for slow music and flowers.

One company figures that any airport-to-post office mail run that takes a truck 30 minutes can be negotiated by a shuttle helicopter in a maximum of five minutes.

Sikorsky's helicopters capped a series of extraordinary performances in the war with peacetime records. One of the big ones built for the Army carried 18 persons a



SIDE BY SIDE



Kellett XR-8, Army machine, has intermeshing rotors. Its 245-hp. Franklin engine is behind pilot.

TORQUE CORRECTION BY JET





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## HELICOPTERS ARE IDEAL

short distance off the ground. It also flew to a height of more than 21,000 feet and made 114.6 miles an hour in level flight.

Problems in helicopter design remain. A helicopter does things that baffle even the best of the engineers. That is understandable. Less than a quarter of one percent of the engineering spent on perfecting the airplane has been expended on the helicopter. It is about where the automobile was in 1905. It must develop not only greater efficiency but also more speed, more stability —the kind that permits a motorist to take his hands off the wheel momentarily at 50 miles an hour—and less vibration.

Efficiency is improving. The earliest helicopters barely were able to stagger off the ground. Today's carry a "disposable load"—fuel, passengers and baggage—of a fourth of their gross weight. The disposable load of an airplane varies from a third to nearly a half of the gross weight.

Stability is improving. By using a stabilizing bar working on the gyroscopic principle, plus a two-bladed "teeter-totter" rotor that obviates flap hinges at the blade roots, Bell has proved that stability can be increased and vibration decreased.

The assorted rotor combinations being used by the 51 U. S. companies and individuals making helicopters or experimenting with them show (in drawings at bottom of pages 84-87) that the designers are wallowing in a sea of undigested research. They know they must simplify the rotor systems to cut cost and make servicing easier. They know they are not getting enough lift out of their blades. They know that jet-propelled blades would solve many of their problems at one fell swoop. Jet propulsion, whirling a rotor just as water whirls a lawn sprinkler, automatically would dispose of torque. Torque does not develop unless power is applied directly to the rotor. But jet reaction applied to helicopters is exceptionally wasteful of power.

What the helicopter people would like most to know right now is what rules are going to govern helicopter flight. If helicopters are forbidden to land in midtown, their usefulness will be cut in half. That's where helicopters shine—doing things that airplanes can't.

Pilot Carlson of the Bell company gave me a ride in the first and, as yet, only helicopter commercially licensed by the federal government. It is a two-place job with a 175-horsepower engine that cruises at 80 miles an hour. Once off the ground, I could understand why helicopter people get wacky over their machines.

We sat in a comfortable cockpit like that of a small airplane except that a plastic bubble took the place of fabric and metal. It contained one additional control, that for rotor blade pitch. Carlson nudged the throttle open. We went faster, straight up, than the world's fastest express elevator.



One-place "Roteron's" 25-hp. motor is mounted between coaxial rotors.









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PIPE-LINE PATROL



POWER-LINE MAINTENANCE

One moment the ground was a couple of feet below. Seconds later it was hundreds of feet below.

Forward flight was like that in an airplane. Certainly there was no more vibration than there is in an airplane. Possibly there was less. But I did notice an odd, modified gallop. It felt like an automobile on a washboard road.

"That's not normal," explained Carlson. "The blades need adjusting. You get that when one blade doesn't 'track' in the path of the other one."

The helicopter gained and lost altitude and speed at his will. Though an extremely strong wind was blowing, we felt no air bumps. The whirling canopy of blades above us smoothed them out. We came around for a landing quite high and very fast, and of a sudden we were just hanging there in space. Carlson had gone from 60 to 0 miles an hour in a twinkling. A helicopter can stop twice as short as an automobile.

"This is an autorotative landing," he said.

He throttled back. The rotor, freed of the engine through an over-running clutch, spun on its own as our descent produced a rush of air against the blades. We had gone up like an elevator, and now we came down like one. The helicopter glided like a streamlined brick. Then, just off the ground, Carlson hauled back on the stick. The blades cushioned the fall and the wheels touched as light as eiderdown at a forward speed that could have been no faster than a walk.

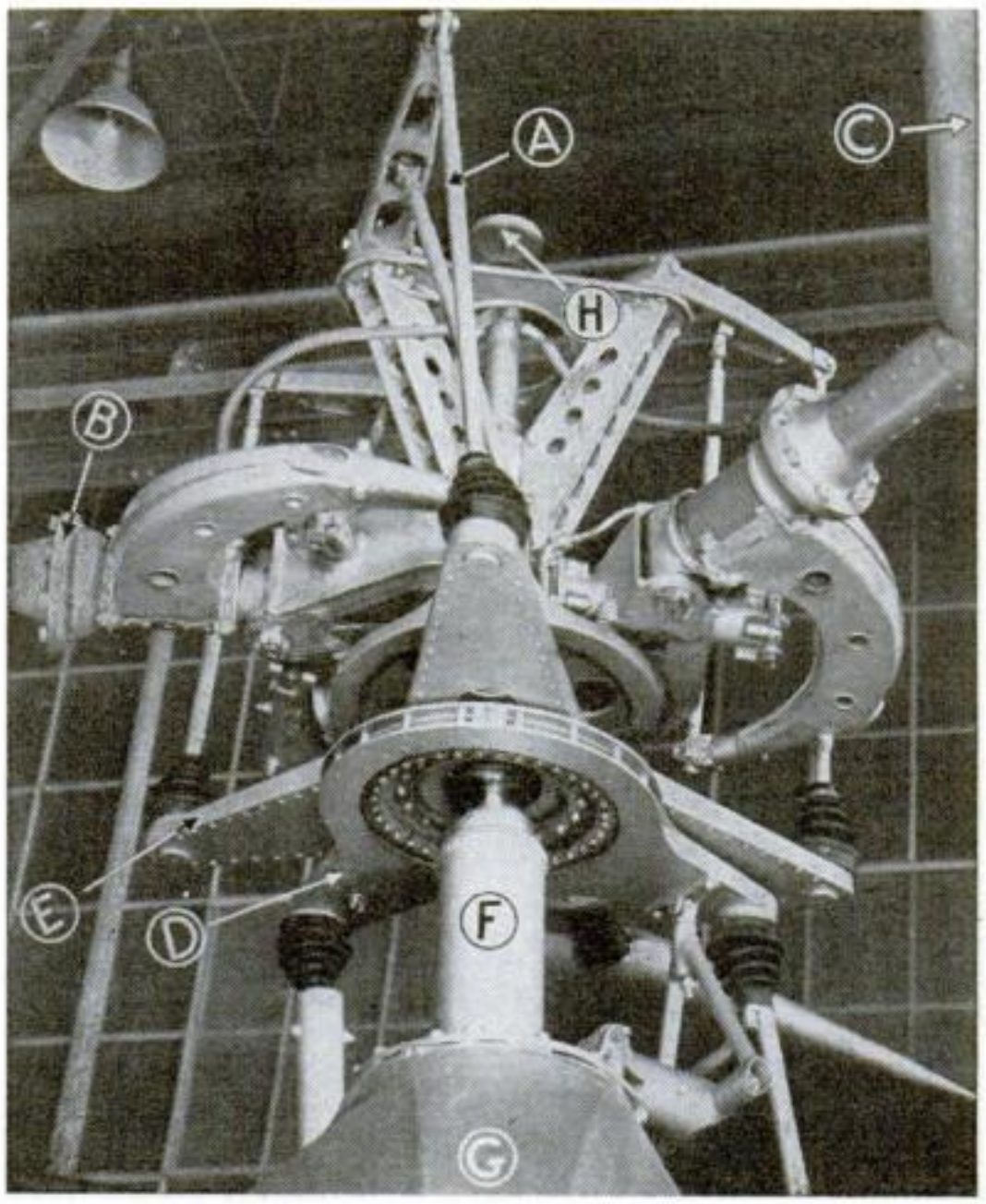
For fun, Carlson took off again, backed up a few feet and landed with engine power.

One of the company employees, who has been watching the helicopters fly for years, was waiting for me as I climbed out. "That was wonderful," I said, "and now let's go get a beer."

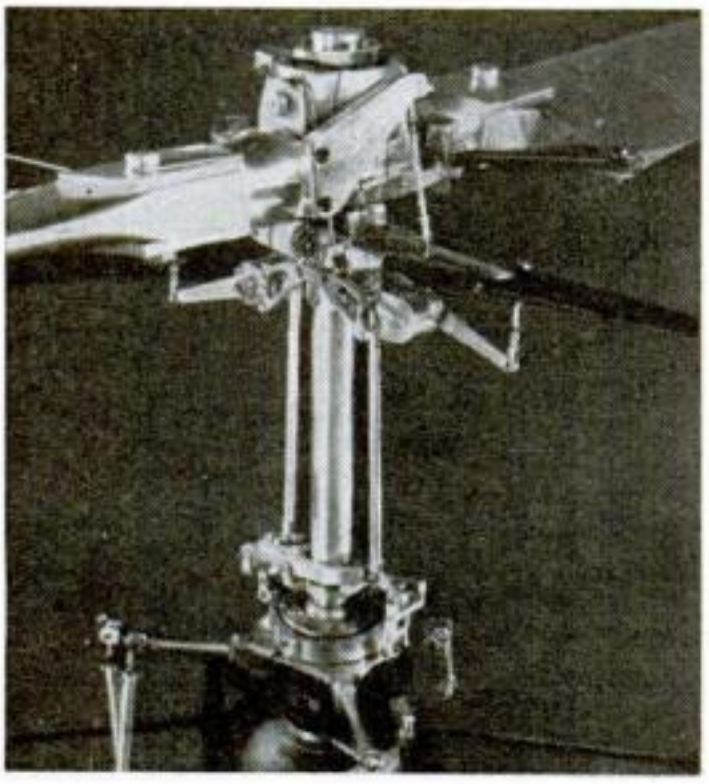
"Do you mind waiting a minute?" he replied. "I want to see the ship make one more hop."

That's the way helicopter people are.

Sikorsky rotor head (at right) consists of (A) pitch-control levers, (B) cuff or blade attachment, (C) blade, (D) "wobble plate," (E) cyclical pitch control, (F) main rotor shaft, (G) supporting pylon, and (H) hydraulic fluid.

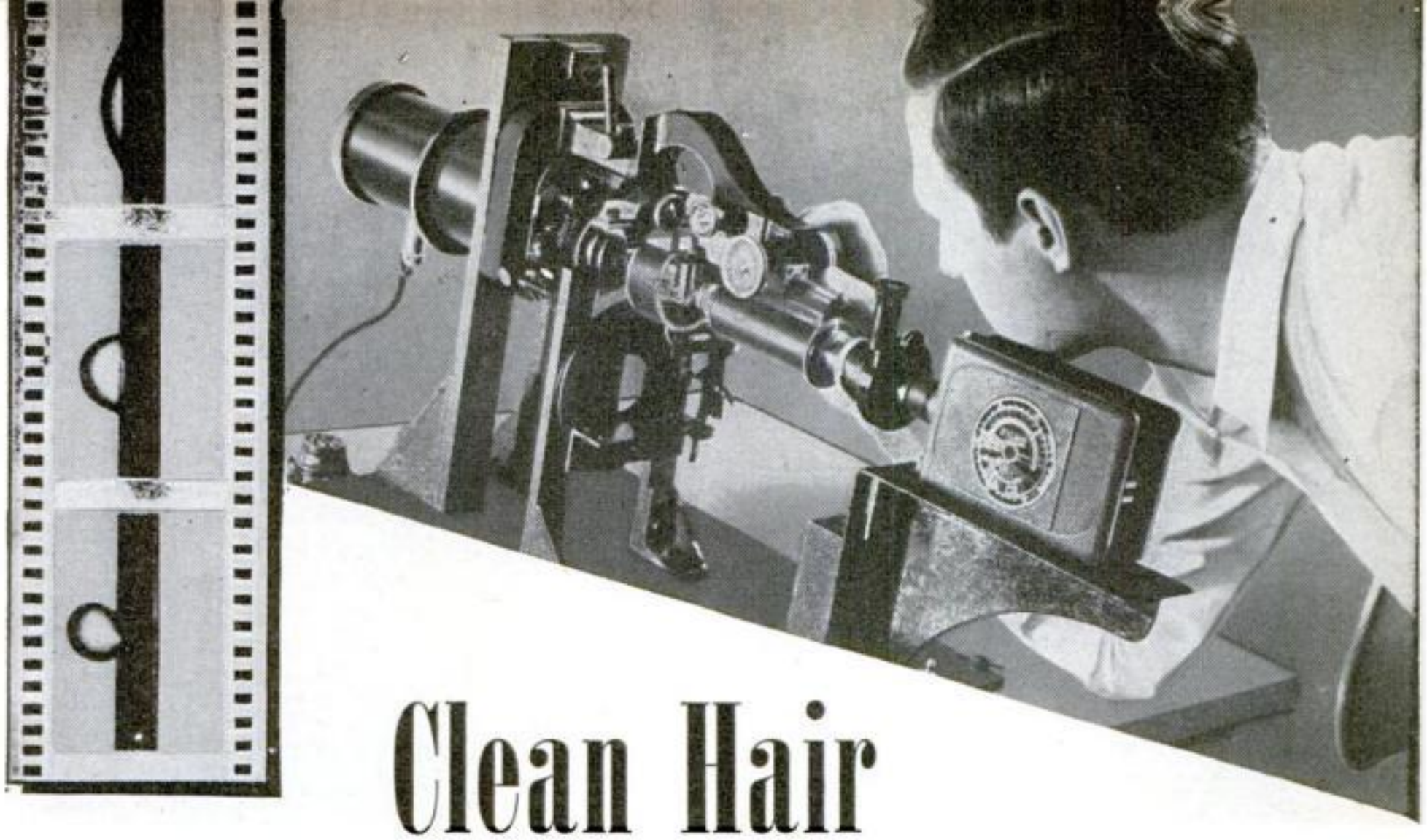



Bell rotor head uses "cyclic pitch" but also incorporates special stabilizing device.





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# Clean Hair

## *Assured by Microscope Movies*

### First Films of Hair Washing Show Chemical's Action

THE average human head supports 130,000 hairs. Every time the world washes its head, approximately 286,000,000,000,000 hairs are scrubbed. But only recently has anyone made a moving picture of a single hair being washed. Those pictures indicate that the most efficient shampoo is an alkyl-sulphate solution. Alkyl sulphate is made by reducing fatty acids by catalytic hydrogenation under high pressure and treating the product with sulphuric acid.

The movie, produced by Procter and Gamble Co., was made by focusing a microscope on a single hair and then taking moving pictures through the microscope. It shows (above) how alkyl sulphate picks up a bubble of dirt and oil and floats it away. When soap was used, it combined with natural water salts and formed an insoluble lime deposit in which some of the dirt and oil were incorporated. A sticky blob of this soap curd could be seen on the hair during and after rinsing.

Alkyl sulphate is chemically similar to soap. Both are salts of organic compounds containing long carbon chains, with sodium, potassium, ammonia or other soluble bases. Alkyl sulphate is fundamentally different in that it consists of sulphate ester salts and not carboxylate salts. It suds and cleanses in alkaline, neutral and acid solutions, and it does not form a scum in hard water.

## About the PAPER *in Popular Science Monthly*

Like every big publication, *Popular Science Monthly* has been hard hit by the paper shortage. We are forced for awhile to take, and use in part of each issue, a quality of paper way below our standard. We don't like to see fine illustrations come out on the page looking like soft coal on a tablecloth. But we would rather risk poor paper than cut down the number of copies of your magazine—or worse, the number of editorial pages, which for years has run the same in every issue. As soon as possible, PSM will restore the fine, white paper that helped make it such a well-printed, easy-to-read magazine in the past.

**—The Editors**



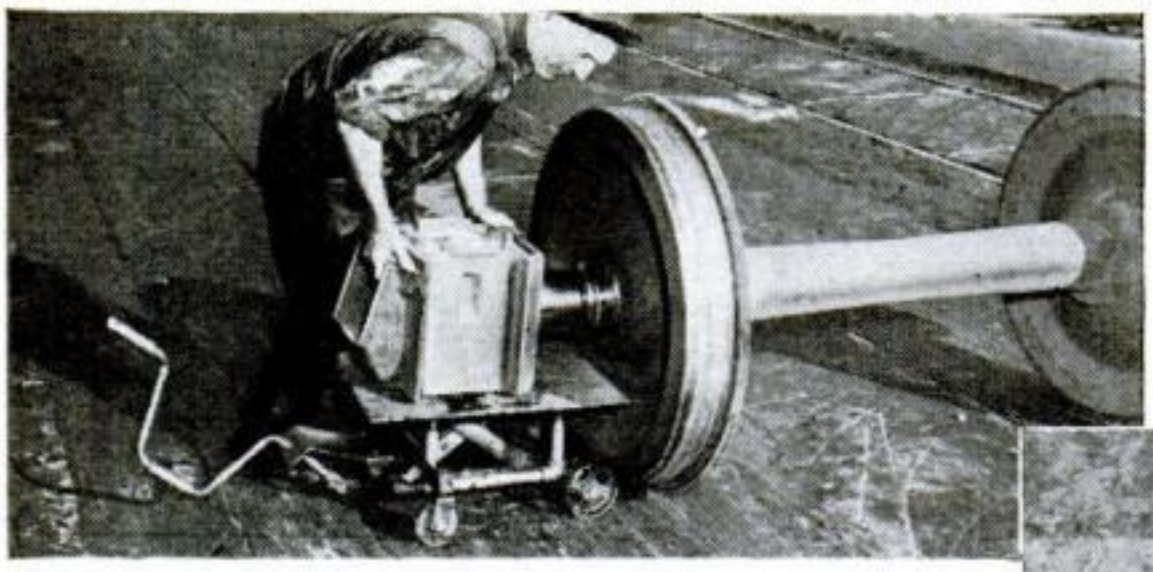
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Cutting grease and grime away from a streamliner's wheels with live steam. Workers used to direct nozzle by hand and carry hose. This improvised tripod with swivel top now speeds job.

# Rail Workers Turn Scrap into Tools

Working on the railroad is easier than it used to be for Southern Pacific employees because of labor-saving devices they have built for themselves, usually out of scrap.



Changing journal boxes is no longer a laborious job when the small hydraulic hoist above, devised by workers in the Southern Pacific's Los Angeles yards, is used.



The big jack above, made of second-hand parts, compresses the elliptic springs for car trucks. The whole car used to be jacked up.

It formerly took two men to install triple valves on a locomotive. One can do it now with the simple, improvised jack at left.



It takes less time and effort to load ice on diners with the help of a tractor-operated lift, which hoists eight 300-pound cakes






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# Atomic medicine

## *can lengthen your life*

**With available radioactive aids, doctors could learn far more about how your body works.**




Man has more than doubled his life span since Roman times. Atomic medicine now promises to stretch it farther.

**By CARL DREHER**

IN 1912 Dr. Georg von Hevesy, a young Danish scientist, was at Rutherford's laboratory in London, experimenting with radiation and radioactive atoms. Hevesy was a bachelor and lived at a boarding house, where the meals aroused his suspicions. One Sunday he left a little radioactive lead with the remainder of his meat. Thereafter, every day that week, he took a sample of the meat that was served to him back to his laboratory, and on each day he found it contained a trace of radioactive lead![1]

This was probably the first application of tracer technique in biology, a method that now seems destined to clear up many of the obscurities that handicap physicians. Therapy will follow as the atomic bomb followed knowledge and necessity. Tracer research, in short, means that many of us will have a chance to live longer, happier, more productive lives.



Dr. Georg von Hevesy's doubt about his hash made history.

The radioactive lead that Hevesy used in 1912 was radium-D, an intermediate product of the spontaneous disintegration of radium, which meant that there wasn't much of it. Moreover, it was poisonous and hence unsuitable for experimentation on living animals except in very minute quantities. But now practically all the elements, including the common organic components such as carbon, nitrogen, phosphorous, sodium, iodine, and hydrogen can be made radioactive. So medical researchers really have something to work with.

These materials are produced by taking a common element, such as red phosphorus, and bombarding it in a cyclotron, an electrostatic generator, or, now, in a uranium pile. Thereupon a radioactive *isotope* is produced. An isotope is a form of an element that differs in atomic *weight* from the original, because something has been knocked into or out of its nucleus, but does not differ in atomic *number,* or the surrounding electrons that determine its electrical and chemical properties. Thus the common phosphorus that is exposed to the action of the cyclotron is $_{15}P^{31}$, meaning it has 15 electrons revolving in its outer atomic space, and 31 heavy particles in its nucleus. After bombardment with deuterons (heavy hydrogen particles that are themselves isotopic) the phosphorus that emerges is $_{15}P^{32}$: each atom still contains 15 electrons, but the atomic weight has been raised from 31 to 32.

No chemist can distinguish $P^{32}$ from $P^{31}$ by the older chemical methods, nor can the body tell them apart. But whereas $P^{31}$ is stable, $P^{32}$ is radioactive—it emits beta particles, high-speed electrons. In 14.3 days half of these particles will be gone. That is the half-life of this material, which nothing can alter. While it is emitting them, it can be detected wherever it goes, in quantities defying the most refined chemical analysis.

A dynamic picture of what happens in a

[1] *Radiology,* 35:174, August, 1940.



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living plant, animal, or human body, when the organism is functioning normally is thus obtainable. You don't have to overdose it to get a detectable chemical response. The researcher has a tool a million or more times as sensitive as the best quantitative chemical analysis. He can distinguish between a substance previously present in the tissues, and the same substance newly added—as Dr. Robley D. Evans puts it, between the atoms of phosphorus in the enamel of a rat's teeth, which have been there for months, and the atoms of phosphorus that the rat took in at its last meal. Such advantages, combined in a single technique, make this development really momentous.

A number of instruments can be used for tracing and measurement. Photographic emulsions, for example, are fogged by radiation. This property, by which Roentgen discovered the X ray, is employed in the film badges worn by workers in the atomic-bomb plants. Following processing of the film, the amount of darkening can be read on a densitometer, giving the health authorities a record of the amount of radiation received.

Film detection methods are very sensitive. They add up all the radiation received during the entire exposure. But for precisely that reason they do not tell us what happened during any particular part of that period. Specific measurements as of a given time are made with the Geiger-Muller counter (PSM, Feb. '46, p. 121). Its basic element is a glass tube filled with gas at reduced pressure and containing a fine wire running lengthwise through a metallic cylinder. The wire is at a potential of about +1,000 volts with respect to the cylinder. When the tube is placed over the region to be studied the radiation passing into the space between wire and cylinder produces ionization,or electrical conduction, by knocking electrons out of the gas atoms. The result is a surge of current between the two electrodes. In this indirect fashion the instrument acts as a sensitive chemical balance.

This sounds a great deal simpler than it is. Different sorts of radiation do not pass into the ionization space with equal ease. The tube has to be shielded as far as possible from all radiation other than that under observation. Correction has to be made for stray radiation, such as cosmic rays, and the tube and its associated amplifier must be kept in a constant state of sensitivity. The design and operation of Geiger counters is thus a fine art in itself. This, in fact, is true of the whole tracer technique and its applications. It represents an epoch-making development, but one that requires the patience of a Job and the vigilance of an Argus. It is a field for only the most devoted and highly trained scientists.

Not all isotopes are radioactive, and some stable, nonradioactive forms are fully as useful in tracer work as the unstable forms. Heavy carbon, $C^{13}$, is one of these. Since carbon is the principal constituent of living matter, any special form of it is of the utmost importance. Likewise for heavy hydrogen ($H^2$) and nitrogen ($N^{15}$). These materials are traced by spectroscopic methods and by the mass spectrograph, which measures the masses of individual isotopes and thus permits us to distinguish between atoms of different weights.

The utilization of carbon, nitrogen, phosphorus, iron and other elements and their compounds is basic to life, yet we do not know too much about what happens to them in our own bodies or in plants and animals. How is each substance assimilated? What transformations does it undergo in the tissuses? How is it eleminated? Controversies have raged for decades about such questions, simply because of the inadequacy of our means of studying them.

Thus we know that iron is a vital element in the action of the blood, and there is a vast literature on its transport and chemistry in the body, yet Howell, the leading text on physiology, ends up by declaring, "The whole history of the metabolism of iron in the body is surrounded by much uncertainty." Now radioactive iron enables the investibator to differentiate between iron already present and new iron taken up by the blood. So radioactive iron is being used in experiments on normal animals and on animals with artificially induced anemias and a resulting iron deficiency. In time the results may be reflected in the treatment of anemia and other blood diseases in human beings.

Even in fields that have been developed satisfactorily by the older chemical methods, isotope studies may furnish more exact data and eventually improve medical practice. A great deal was known about the secretion of iodine by the thyroid gland before the development of nuclear physics, but tracer studies using radio-iodine enable us to draw accurate curves of the absorption of iodine by healthy and diseased thyroids. Such studies are particularly important in the case of growing children with abnormal thyroids, since a disturbance in this quarter inevitably upsets the balance of the whole glandular system and interferes with normal development.

Another practical application of the tagging technique has clarified the failure of some diabetics to respond to insulin.[2] It was known that this was caused by failure to absorb the drug quickly enough after in-

[2] *Journal of the American Medical Association,* Jan. 8, 1944.



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jection, and that in certain cases this was due to the practice of injecting repeatedly in the same areas. Pads of scar tissue and fat developed under the skin at these points, making the injection painless and encouraging the patient to continue using that same spot. But the pads also retarded the absorption of the drug. Exactly how much was determined by marking a ¾-inch mercurochrome ring on the skin, in the center of which a standard injection of insulin, tagged with radio-iodine, was made. The Geiger-Muller counter was then placed over the marked ring and the count recorded; this was repeated at intervals of 20 minutes, one hour, and two, four, and eight hours. Thus the rate at which the insulin left the injection site was accurately measured. It was found that after two hours, instead of absorbing 40 percent of the insulin, one patient had absorbed only 10 percent. Of course he was not getting enough insulin, and his sugar content rose accordingly. These tests showed that the advice given to diabetics to rotate areas of injection so that a given site is not used more than once a month is no mere flight of the physician's fancy.

Another example of the use of the tracer technique[3] goes back to the Prohibition era. Many thirsty midwesterners tried an alcoholic extract of ginger, which the Prohibition Bureau had optimistically ruled to be nonpotable. An epidemic of paralysis of the extremities, especially the feet, broke out among the consumers, and public health authorities were faced with a serious problem. Several months of intensive investigation revealed that some of the ginger extract had been adulterated with about two percent of a phenol compound known as triorthocresyl phosphate—TCP—the toxic qualities of which had up to then been entirely unsuspected.

In the 1940s this same drug began to assume industrial importance, and the question arose as to how it would affect workmen who handled it in the processing plants.

[3]Given by Drs. Harold C. Hodge and James H. Sterner, of the University of Rochester, in *Journal of Pharmacology and Experimental Therapeutics*, November, 1943.

CENSORED
(See page 7)

CENSORED
(See page 7)

CENSORED
(See page 7)

Workers on the Manhattan Project wore small ionization chambers, shaped like fountain pens, in their pockets (below). Any decrease in their charge, read on a special electroscope at the end of each day, showed how much ionization (caused by radiation) had occurred since morning.

In a special laundry where the laboratory clothes of people working on radioactive substances were decontaminated, the instruments above measured radiations that might be coming from the clothes both before and after they were laundered.

The film badge (left) was a good check against pocket ionization chambers. Workers regularly exposed to radiation in atomic-bomb plants had to wear both. All the film except for a small window was covered by a thin metal shield. Radiation that passed through the paper protecting the film in the window clouded the film's emulsion.



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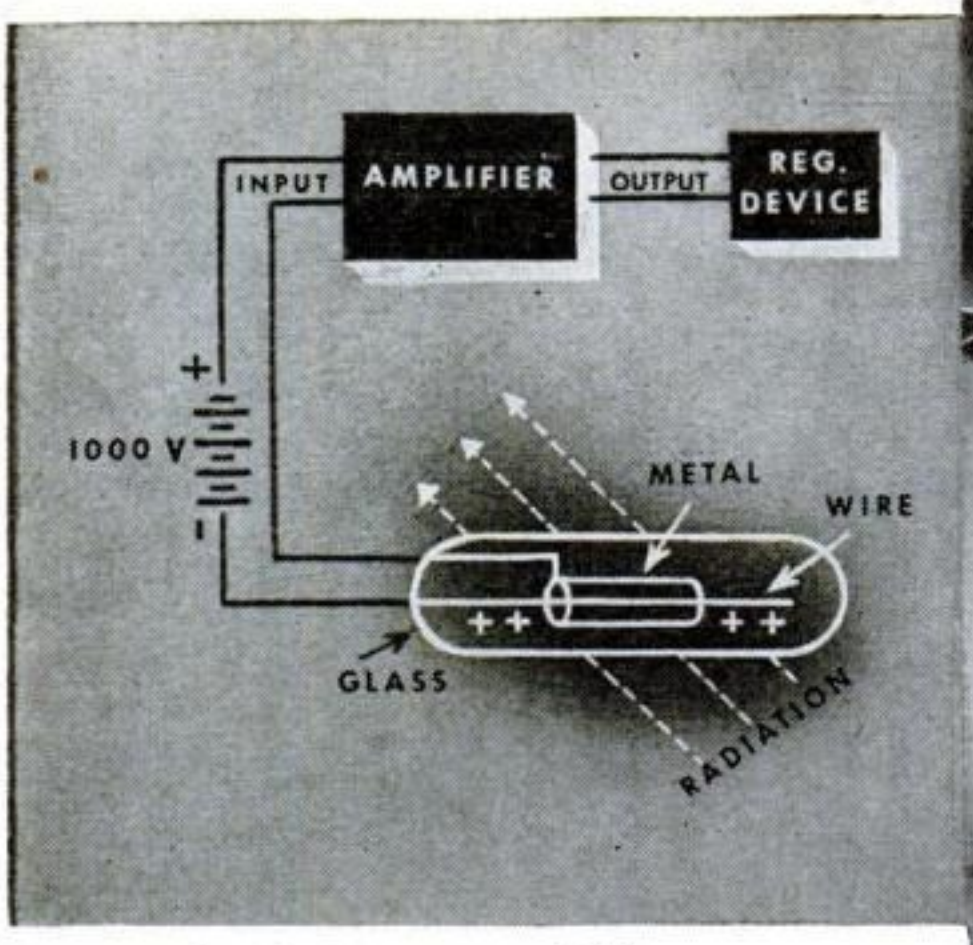
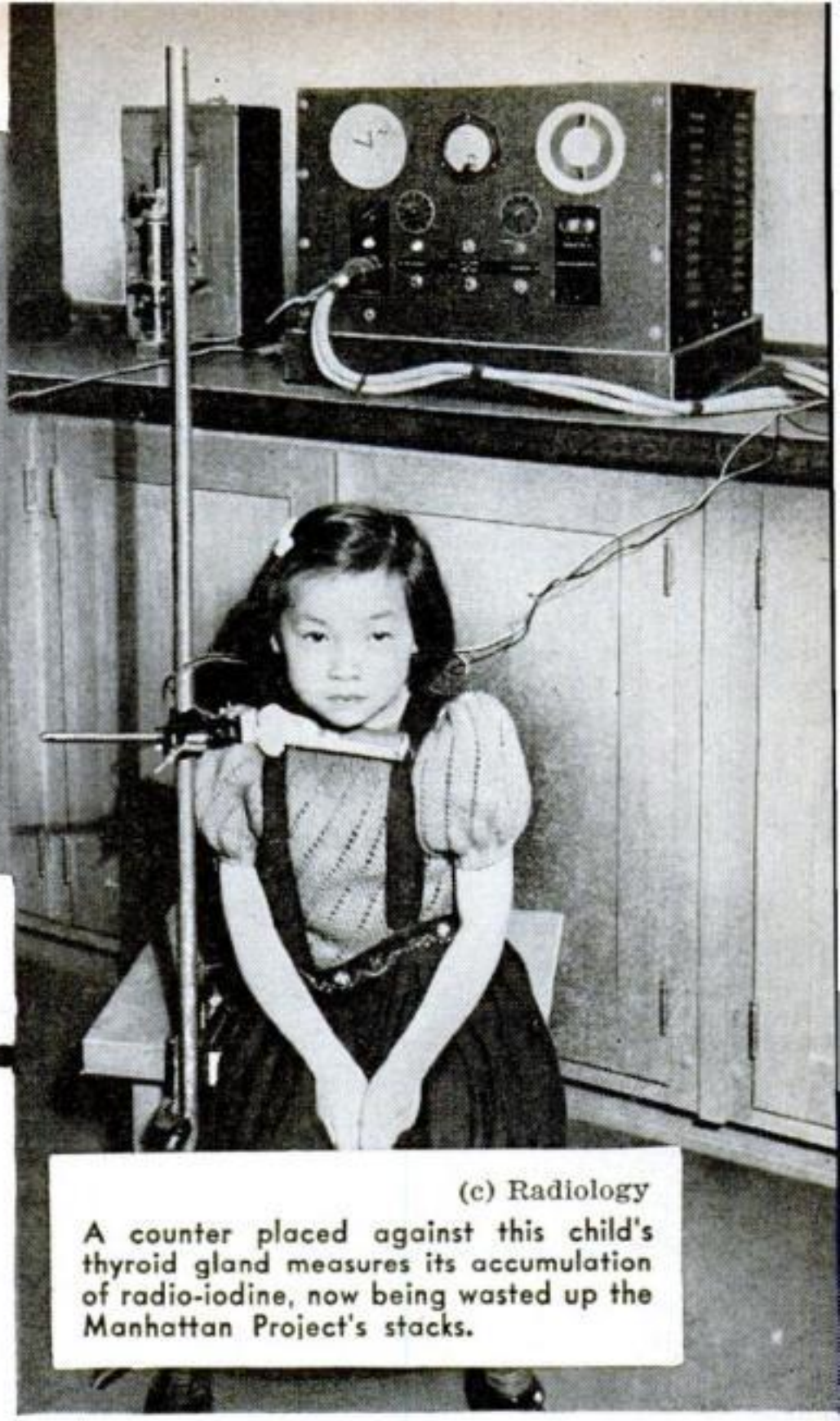



Diagram of a Geiger counter, highly sensitive detector of radiation. A single charged particle, entering the gas-filled tube, can be recorded.



(c) Radiology

A counter placed against this child's thyroid gland measures its accumulation of radio-iodine, now being wasted up the Manhattan Project's stacks.

Specifically, how much of it would they absorb through the skin of their hands? The radioactive tracer technique was employed. Experimenters applied small quantities of TCP, labeled with radioactive phosphorus, to the palms of their hands. Blood and urine samples then were tested for radioactivity and the amount of the drug absorbed was calculated. Very appreciable quantities rapidly entered the blood stream. Consequently there was serious danger that workmen handling the stuff routinely, without precautions, would develop "ginger paralysis." Animal experimentation confirmed this conclusion. Processing methods were accordingly modified to prevent skin contact.

More recently, studies of the healing of bone, made on rats, have been reported.[4] The animals were anesthetized and lengthwise cuts made in their leg bones with a small circular saw. During recovery they were fed radiostrontium and radiophosphorus, and the uptake of these substances by the healing cut was measured with a Geiger counter. The results indicated that the time required to reach a maximum uptake might be used as a measure of healing. Presumably this could lead to evaluation of the mending of fractures in human subjects.

About half a million Americans suffer from epileptic seizures of varying intensity. The causes of this disease are still largely obscure. The psychological make-up of the epileptic has been studied, and comparisons have been made between the electrical waves of the brains of normal subjects and those that characterize epilepsy. Now the metabolism of the brain is being studied by means of radioactive sodium and potassium used as tracers—in the hope that the biochemical basis of epilepsy may be discovered[5].

Tracer technique, however, is not the only contribution of nuclear physics to medical research. There is also the direct radiation from the cyclotron and other nuclear transformers, which may prove preferable in the treatment of some cancers to the older types of radiation generators, such as the X-ray tube and radium. To make this possible it is first necessary to *collimate* the output of the newer devices, to project the particles in a beam that can be directed on a particular region of the body. But control of the radiation is only a beginning. It is equally necessary to know how much can be used safely, i.e., to standardize dosages. In some instances the answers are known; others are

[4] By Drs. Alfred Marshak and R. L. Byron in *Journal of Bone and Joint Surgery*, January, 1945.

[5] This work is being carried on at the University of California Medical School.



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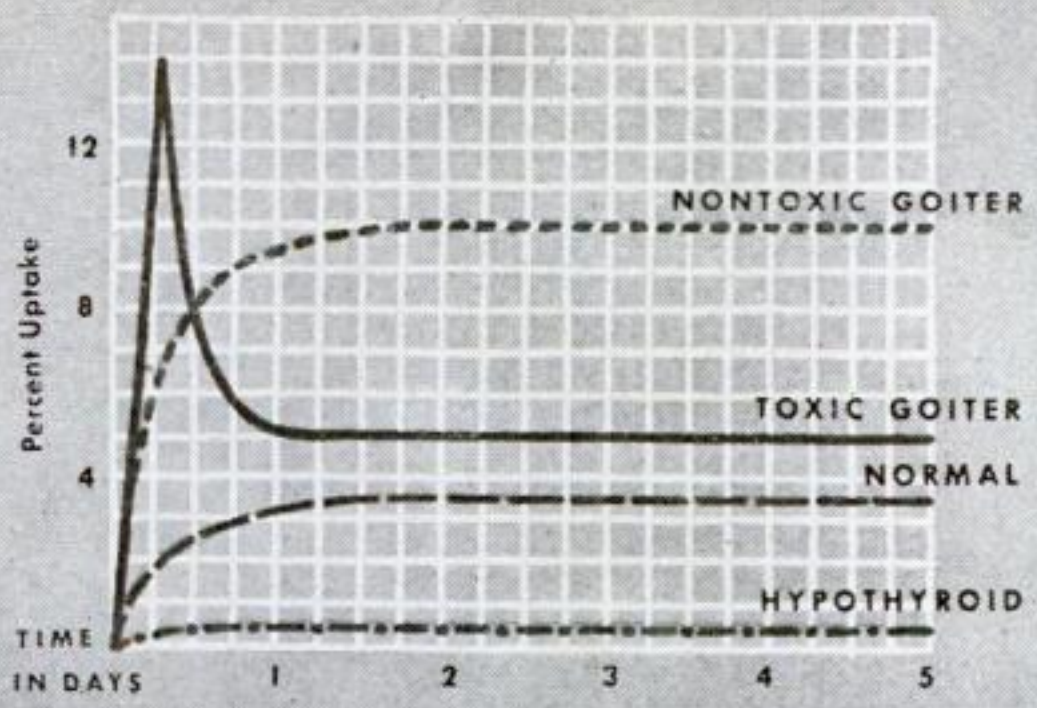
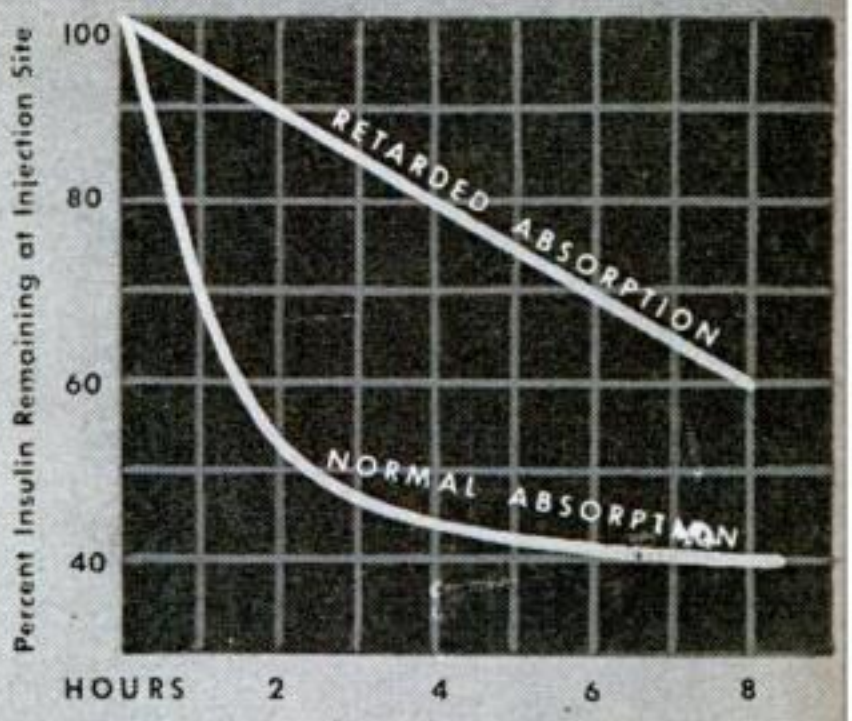



Chart shows the speed and degree with which thyroid glands in various condition absorb radio-iodine. Sharp peak marks impact on toxic goiter.




Counter record of how two diabetics responded to radioactive insulin. Top line shows how absorption was retarded by fat at the injection point.

still in the stage of animal experimentation. One method is to cultivate malignant tumors in mice, expose fragments to definite quantities of radiation about which information is sought, transplant the fragments to healthy mice, and compare the proportion of resulting "takes" with similar tumor sections exposed to X-radiation. It takes thousands of tests of this sort before application to human beings can be thought of.

These are only a few samples of the work being done. Artificially produced isotopes have been available less than 12 years. Soon after the investigators developed their techniques and the materials began to be available in practical quantities, the war broke out and long-term medical research took a back seat for four years. E. O. Lawrence tore apart his biggest cyclotron, then under construction; the electromagnet was needed in the atomic-bomb project. The older cyclotron, in which a good part of the isotopes used in medical research had been produced, was also turned over to the Manhattan District. Most of the nuclear physicists went with the equipment, and many of the research teams of physicists and physicians were broken up just when they were beginning to get results. It was all necessary and inevitable, but it was a setback.

Yet it may have been bread cast upon the waters. Those same four years produced not only the atomic bomb, but a prodigious amount of know-how and equipment directly applicable to medical research. At one leap we have moved from the age of scarcity in radioactive materials to the age of plenty. In the production of neutrons one chain-reacting pile is said to be the equivalent of a million cyclotrons, and a good-sized cyclotron is the equivalent, for some therapeutic purposes, of about two pounds of radium, or the entire world stock in 1940.

"Controlled nuclear energy has become a reality," declared Dr. Andrew H. Dowdy, associate professor of radiology and director of atomic medical research at the University of Rochester, in a recent speech. "And with this reality a new era has been born. There is no turning back. The responsibility rests largely in the hands of the American people, but it is a responsibility that must be shared by the other nations. The hazards are admittedly great, but the benefits are so tremendous as to stagger the imagination."

Although we now have, potentially, more radiation than we can use, we still lack trained men—and money. Here, in the greatest and richest country in the world, scientists in charge of research projects concerned with matters of life and death still have no alternative but to run from one foundation to another, raising $1,000 here and $500 there, instead of spending their time in their laboratories. But if we prove capable of an intelligent appreciation of the vital importance of research, scientific medicine is sure to make great strides in the understanding of its subject matter, and, eventually, in the conquest of disease.



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# GRAVEST ILLNESSES *are tasks for* atomic research

THERE is no royal road to therapy. Optimistic expectations that recent developments in atomic technology will lead to a swift and easy solution of the more intractable problems of medicine are doomed to disappointment. Radioactive isotopes and the new forms of radiation are extremely important, but there have been important developments before and people still get sick and die—although they do live a lot longer, on the average, than they used to.

In medicine the toughest assignments always go to the latest arrival. Nobody is calling on nuclear physics for help in combating the ravages of chicken pox or poison ivy: it is the heavyweights like leukemia and cancer that we have to deal with. Abundance of radioactive materials, moreover, will bring hazards in its train as surely as benefits. These are lethal agents, not only against disease, but against anyone who gets in their way through careless or ignorant use. Even experienced radiologists have to watch their step constantly lest, from a few roentgens here and a few there, they accumulate enough radiation to make them sick, or to kill them.

The splendid safety record of the Manhattan Project was the result of first-rate medical supervision, tight military control, and unrelaxing vigilance. Everything—the people leaving the plants, the coats, of the laboratory technicians, the furniture, the water, the very dust in the air and the air itself for miles around—was tested for stray radiation. We don't have to make the country a Manhattan District, but we do have to see to it that radioactive products are released only to people who know their dangers as well as their potentialities. In such able hands, and in no others, these substances can help us conquer the murderous heavyweights among the human body's foes.

All parts of the body are dependent on a continuous and ample blood supply. The lower extremities are peculiarly liable to peripheral vascular disease (vascular refers to blood vessels and peripheral to outlying ones). Prolonged immersion and exposure can also get the legs and feet into grave trouble; there were many such cases in the merchant marine and the air forces during the war.

A surgeon may know he must amputate —but where? There is a great difference between taking off a leg above the knee or below as far as restoration of function is concerned. But if the blood supply is not good enough to enable the wound to heal, the knee will have to be sacrified in a second operation, with all its additional suffering, discouragement, and danger.

What the surgeon needs is some objective method of measuring the circulation of the blood to supplement his clinical faculties. Such a method has recently been reported.[6] A tracer dose of radiosodium is injected into the patient's arm. A shielded Geiger-Muller tube has previously been positioned against the sole of the foot. An electric stop clock is started simultaneously with the injection, and counts per minute are recorded for the next hour. Radiation from the foot increases rapidly at first and then more slowly. A series of such runs on normal subjects establishes a normal circulation pattern in the form of a family of curves. There is considerable variation among subjects, but the highest readings are only about 50 percent above the lowest, and the results—in normal subjects—are the same for both feet.

When something goes wrong with the circulatory apparatus the curves usually, although not invariably, fall outside of the normal range. More *(Continued on page 210)*

[6]By Drs. Beverly C. Smith and Edith H. Quimby of the College of Physicians and Surgeons of Columbia University, in *Radiology*, October 1945.

## PIN-UP

**XB-36 SUPERBOMBER.** This giant Consolidated-Vultee plane, still to be test flown, will be powered by six pusher-type, Pratt & Whitney Major engines, each developing 3,000 hp. plus. The superbomber, which requires a flight crew of 17, will have a maximum gross weight of 132 tons. Its commercial version, Model 37, will carry 50 tons 1,500 miles without refueling.



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17
JOHN T. McCOY, JR.



Inventor Sam Miller demonstrates how easy it is to load his tree-planting gun. Artist's sketch at the right indicates the moving parts and shows a small seedling tree, its roots wrapped, lying in the slot.

A step on the foot rest and another tree is planted for harvest 100 years from now. A man can carry and operate this tool all day without tiring and put in some 2,400 seedlings at a walk.

# NO Squat, NO Stoop

## ONE MAN CAN PUT IN 2,400 SEEDLINGS A DAY

A SMALL, spadelike, tree-planting gun now promises to speed up the reforestation of millions of acres of burned-over forest lands on the West Coast. This little mechanical tree planter was perfected by Sam Miller, an Oregon state forestry employee, after three years of trial-and-error experimentation in the field.

Armed with this sapling-shooter, a workman recently set out 2,400 seedlings in a day on the fire-killed acres of Oregon's vast, 300,000-acre Tillamook burn. Foresters cheered this performance because restocking of burned areas in the past has been laboriously slow. Using the crudest hand tools, it took back-breaking labor to plant 500 small trees a day. Also, with this old method of replanting, labor costs ran to about $15 per acre. With the Miller tree gun these costs are cut to about $5 an acre. This is important, for it means that reforesting burned-out areas is now economically practical for private timberland owners. State and national agencies benefit, too; they can plant three times as much devastated land with the same money.

The new tool looks like a narrow garden spade, except that the blade is replaced by a long, steel finger about an inch by two inches in size. It has only three moving parts: a trigger grip built into the handle, a togglelike spring, and an ejector bar running the full length of the finger and connected to the grip by a steel rod.

To operate the tool, the workman takes a seedling from a carrier hung under his arm, and sets it, roots down, in a depression in the finger of the gun. Placing the daggerlike tip to the ground, he steps on the foot rest and sinks the gun about 10 inches into the soil. He then grips the handle like an aerial gunner squeezing a machine-gun trigger, and the tree is planted.

The general pattern for planting in commercial forests of the West is at six-foot intervals. While the man with the gun is taking two steps along the line he is working, he has time to insert another tree in the slot. Survival of these seedlings planted with the gun during the past three years of experimenting has been almost 100 percent. By the old stoop-and-squat method, survival rarely exceeded 60 percent.



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With the tip of the tool in the ground, operator merely squeezes the grip inside the handle and the tree is in the soil and on its own. The sketch shows how rod trips the ejector to release plant.

After he withdraws the planter, the workman jabs the ground to fill in the soil around the roots of the tree and then stomps hard on the surface to remove air pockets. Another forest giant is started.

# with Mechanical Tree Planter



The old-style method, using a mattock or hazel hoe, was laborious. Only about 500 trees a day could be planted.

The new tree gun will speed replanting of Oregon's 300,000-acre Tillamook burn below.



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# WESTINGHOUSE CENTENARY

**High spots in the long inventive career of George Westinghouse are recreated in these paintings, which are based on meticulous historical research.**

In 1885, direct-current stations served only 16 square miles. Westinghouse found how to extend area by A.C.

"Mary Ann," 2,000-kw. steam-turbine generator, was the first unit of the kind to be installed in U. S.

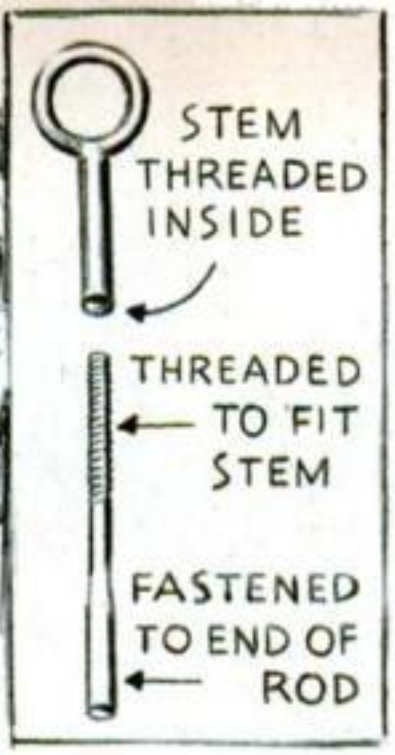
First air-brake train stops short just in the nick of time and convinces witnesses of its quick efficiency.



Big night in Great Barrington, Mass., was when Westinghouse proved that town could be lighted with A.C.

# NEW IDEAS

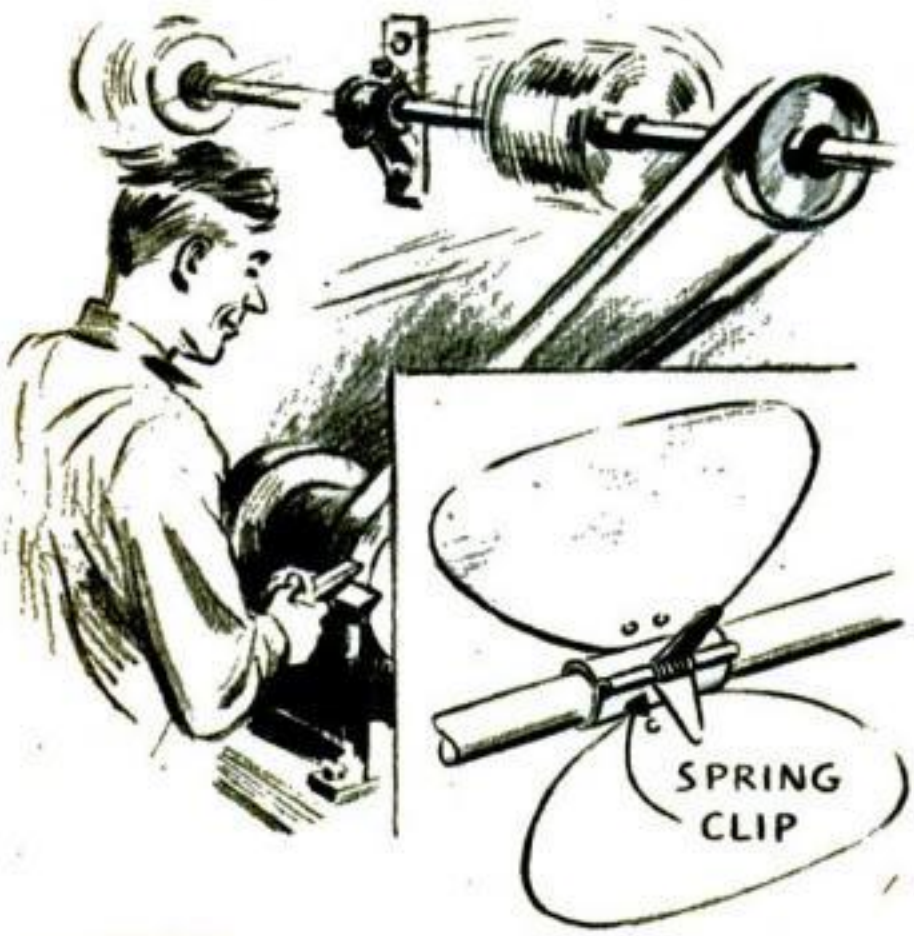





**First Aid to Fishing Rods.** If the tip guide, or eye, breaks at the end of a fishing rod, it can be made good as new at short notice by this invention of Morris S. Licht, Cleveland, Ohio. It consists of a detachable loop threaded to fit a second piece attached to the rod itself. The device may be adapted to fishing rods of all kinds and sizes, whether they are made of bamboo or of steel.

**Right Way to Hang Boots.** Here's a simple and convenient new gadget for drying and airing boots, waders, and shoes. It was devised by Harvey W. Hill, Parkville, Mo., to provide a means whereby the damp interiors may be made grippe- and pneumonia-proof. A circulation of air is obtained by suspending the footwear upside down with a clamp arrangement that is easily adjustable with a nut to the size of the sole. A hook attached midway of the clamp permits the boot to be hung from any hook. Gravity makes the water drip; ascending warm air dries the inside.



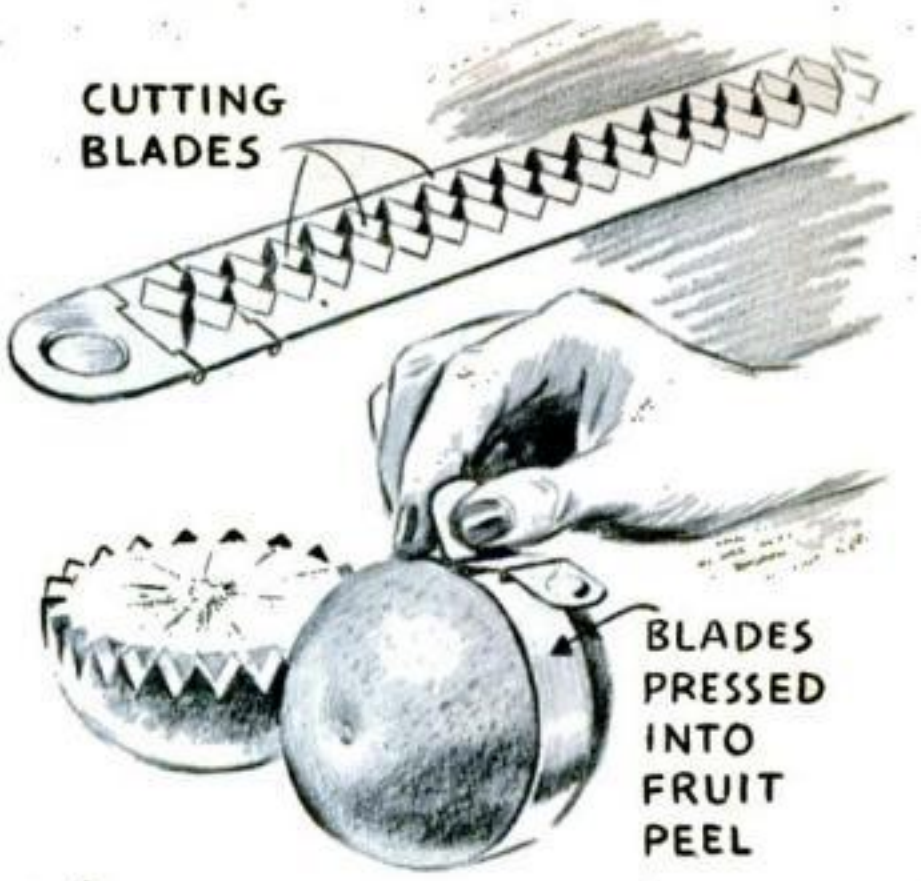

**Clip Fan for Line Shafting.** For the comfort and efficiency of workers in factories where line shafting is used and ventilation is bad, Louis A. Gutkin, Winnipeg, Manitoba, Canada, has invented a two-bladed fan that can be clipped to the rotating shaft above a workbench. Blades may be made of any light material, such as a building board, plastic, or metal, and, through a variation in the method of attaching to the hub, can be either permanently fixed or adjusted as to pitch. The two-piece hinged collar that grips the shafting is lined with rubber or other suitable material to prevent slipping. The device is simple to manufacture, easy and quick to adjust, and can be adapted to various sizes of shafts.

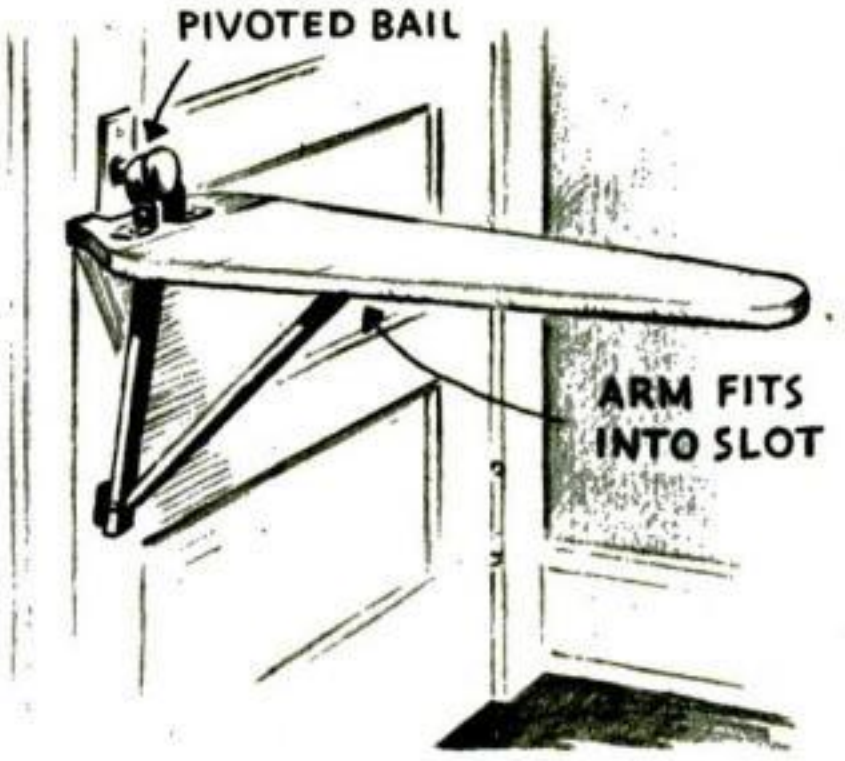


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# FROM THE INVENTORS

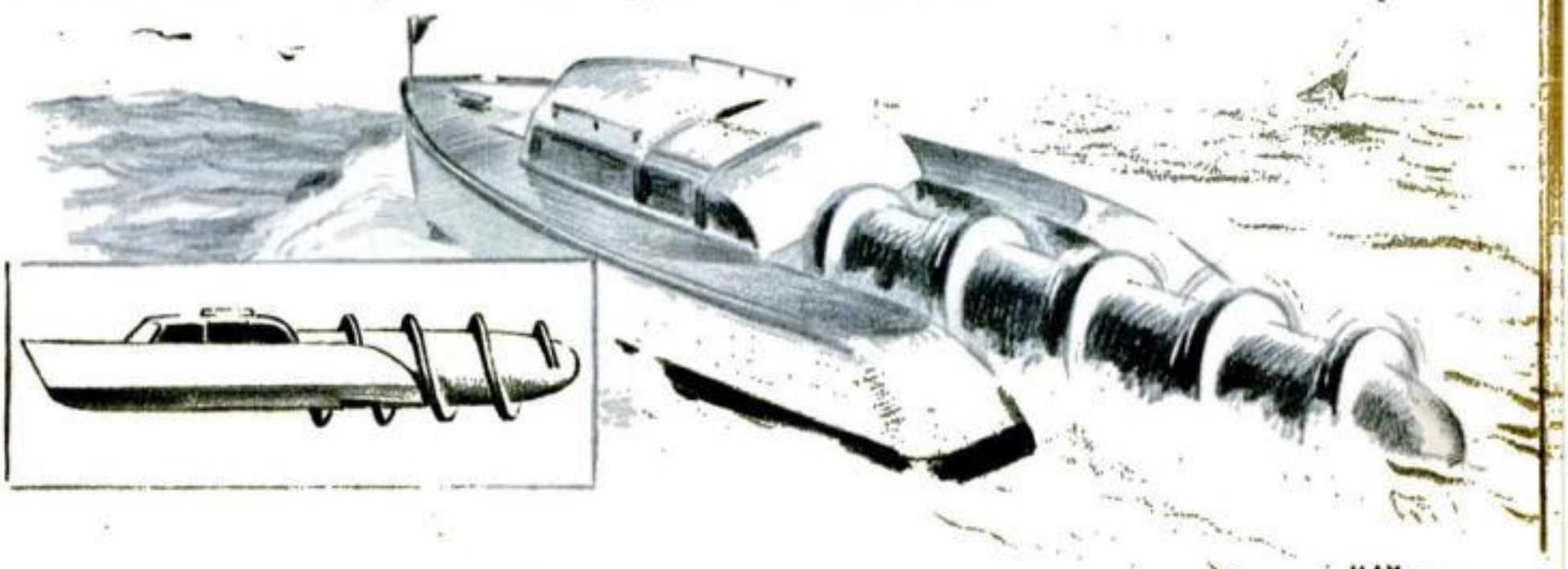
**Fancy Fruit Cutter.** Housewives who like to serve attractively cut fruits will no doubt welcome this flexible band knife, which is the idea of Phyllis K. Fellner, Los Angeles, Calif. The band, with cutting blades on the inside, is drawn around any spherical fruit—oranges, cantaloupe, etc., leaving a deep pattern on the skin or rind. After this is accomplished, the fruit is halved with a knife, leaving the edges as cut by the band. The cutting pattern can be varied so that the edges may be either scalloped or serrated.



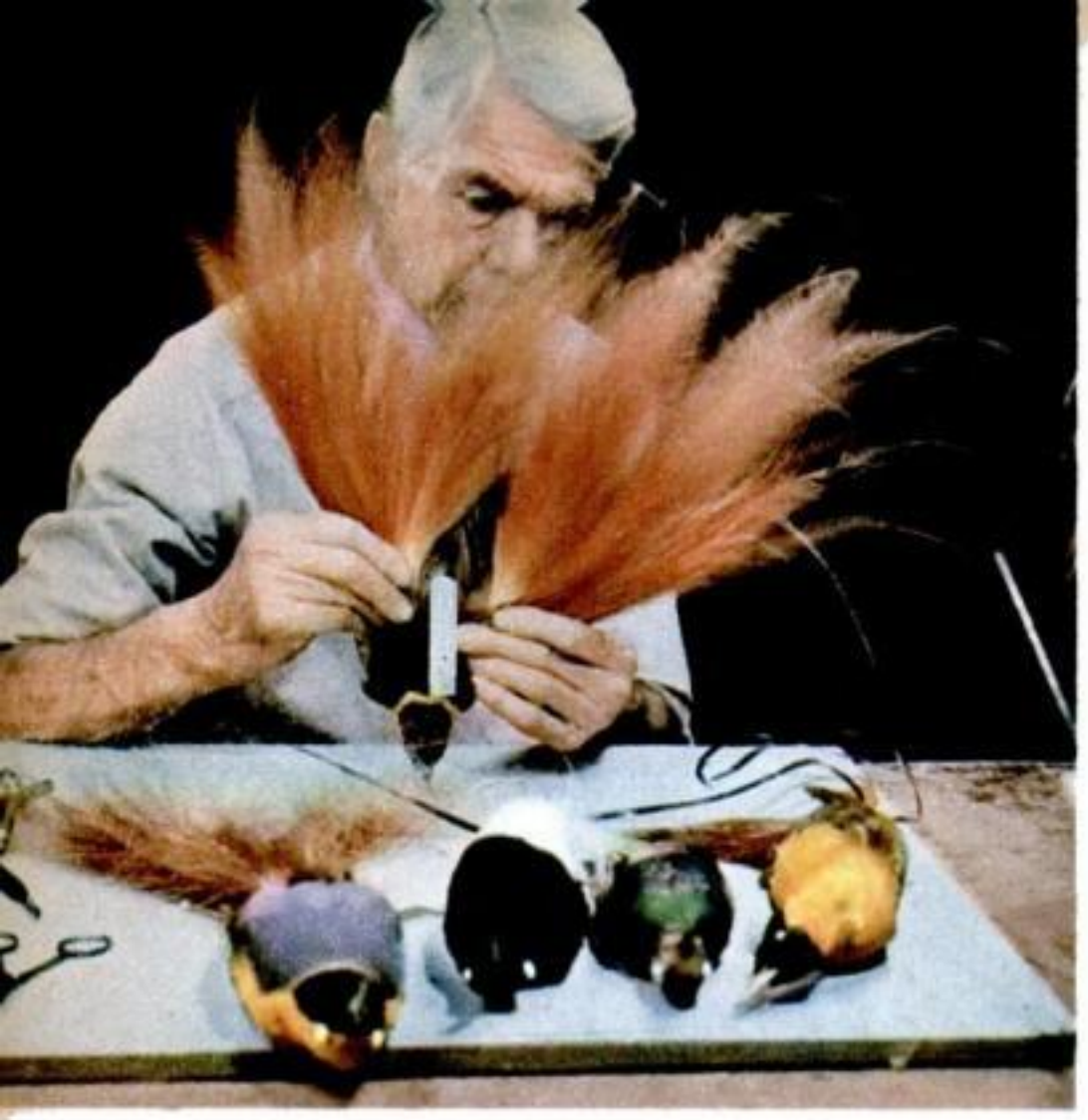

**Doorknob Ironing Board.** Just in time to be of small aid to those suffering in cramped quarters comes this small-apartment ironing board devised by Viggo Rasmussen, of Minneapolis, Minn. It is designed to fold into a readily stowable form, and requires only a moment to set up and attach to any convenient door handle ready for use. A loop fixed to the wider end of the board hooks over the doorknob, and a triangular bracket brace underneath is constructed so as to give it rigidity and prevent side sway in either direction. When the ironing job is finished and the board is collapsed for storage, it occupies little space in a closet or behind any open door.

**The Worm Turns.** The new type of boat illustrated below has been specially designed for propulsion by a kind of turbine in reverse. The after end of the hull is recessed to accommodate the propeller mechanism, which is in two cylindrical sections, one inside of the other. The inside division is stationary and houses the power unit, while the outside section, which revolves, is fitted on its exterior with a spiral fin or blade. When this turns, boring through the water like an auger, there is a long-continued thrust that sends the boat forward at a steady speed. Unlike the conventional propeller, the device makes a continuous "bite" at the water over a considerable distance. Forward of the propeller is a cabin with control apparatus. The man who invented the boat is Harold B. Harvey, Pensacola, Fla.





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## Only Experts Can Mount Gaudy Bird of Paradise

ONE step in the preparation and mounting of birds of paradise—regarded as the most artistic and highly skilled work in taxidermy—is demonstrated (left) by Raymond B. Potter, of the American Museum of Natural History. He is spreading the wing plumes of the male to show the bird in all the brilliance it attains when courting the drab little female.

Found only in the New Guinea area, this gaudiest of birds requires the most delicate handling to display it in an erect and lifelike position. Each quill tip under the skin layer must be set exactly and then "frozen" by a film of clay. For stuffing, excelsior is shaped to the contour of the body, and cotton-wrapped wire is run through the neck and legs.

## Honorable Discharge Pin Has Become Collector's Item

THOUSANDS of men of the United States Maritime Service, who delivered the goods vital to Allied victory, proudly wear the honorable discharge pin shown at right. But official orders recently halted distribution of this pin, thus making it a collector's item.





## New 60-Pound "Plastic Lung" Will Aid Polio Victims

A NEW type of breathing-aid apparatus (above), made mostly of plastic and weighing only 60 pounds, has been developed to help victims of infantile paralysis and others suffering from a breakdown of the respiratory organs. The "lung" also will be valuable as a resuscitation unit.

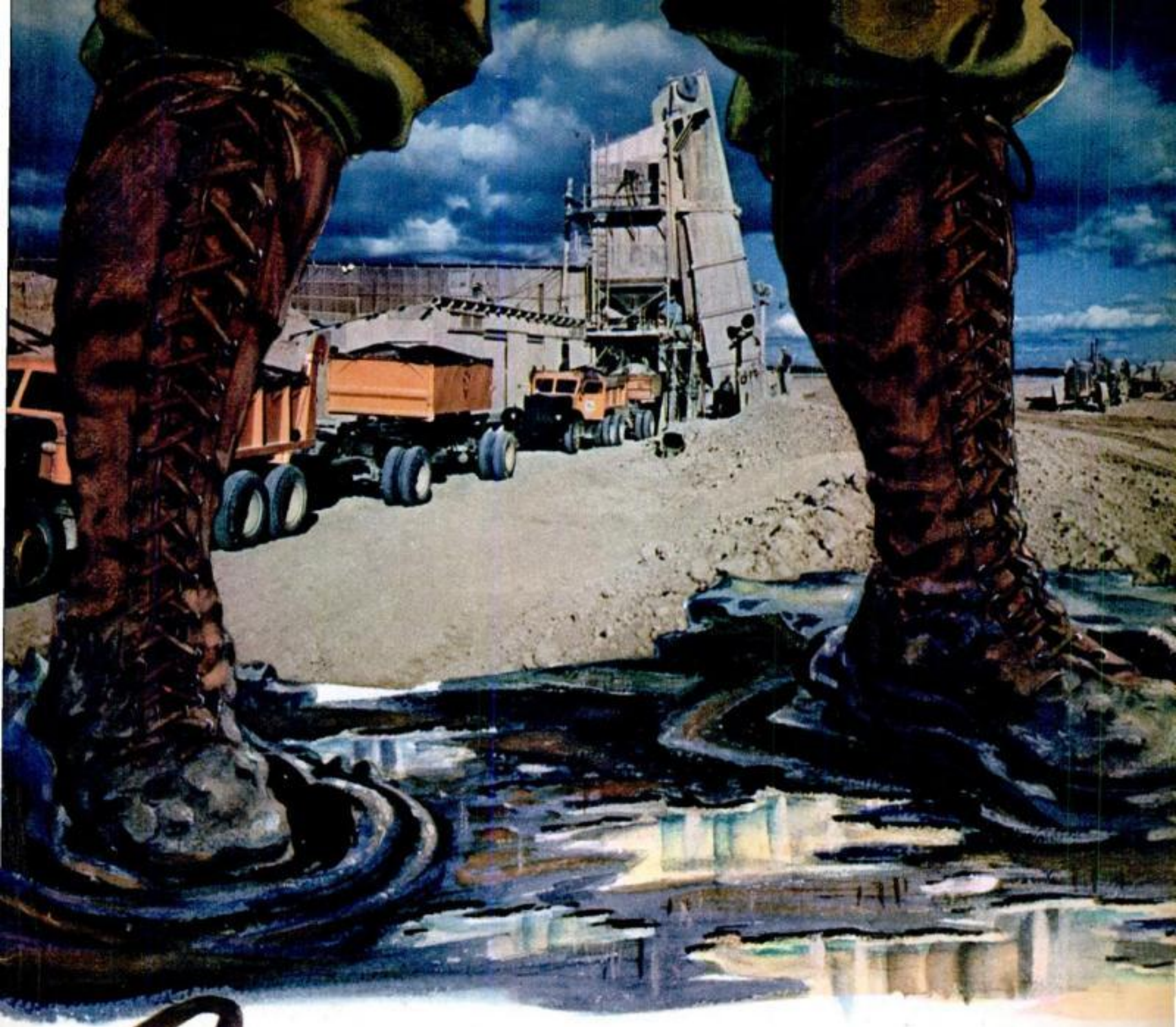
## Treated Oil Won't Bubble Up

THE serious handicap of foaming oil has been eliminated in high-speed motors of trucks, tanks, ships, and other vehicles. Blowing through two straws, the young lady below shows that oil in the beaker at the right, treated by anti-foam agent developed by Gulf Oil Corp., won't bubble over. The beaker at the left shows how air can make untreated oil froth like warm beer.





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# Mud THAT'S WORTH MONEY

Mud, if it is the right kind, saves time and money for oil drillers. Many thousand tons of it are used every year in boring. It's a lubricator, bit cleaner, gas-pressure guard.

## "MINED" IN A DRY LAKE BED, IT LUBRICATES BITS THAT DRILL FOR ADDITIONAL SOURCES OF OIL

THE bearded prospectors who shuffled painfully across Rogers Dry Lake in the Mojave Desert years ago were heading toward gold in the west. But at every searing step they were literally walking on riches. Not gold but—MUD.

The rigs that drill into the earth seeking oil must be lubricated to keep the bit cool, to float off the rock cuttings the bit gouges away (PSM, Dec. 31, p. 20), to "plaster" the shaft so it won't cave in, and to hold down gas or oil that might "blow out" the well by pressure. Most efficacious single substance to perform all four chores is mud —a special kind of mud. The clay that forms the concrete-hard surface of Rogers Dry Lake makes just that kind of mud. It holds water well when mixed. It jells to the required smooth consistency, is not too salty or acid or alkaline. It doesn't contain too much sand. It doesn't set so hard that mud pumps can't break it loose and liquefy it again.

Often a stabilizing agent—caustic soda,



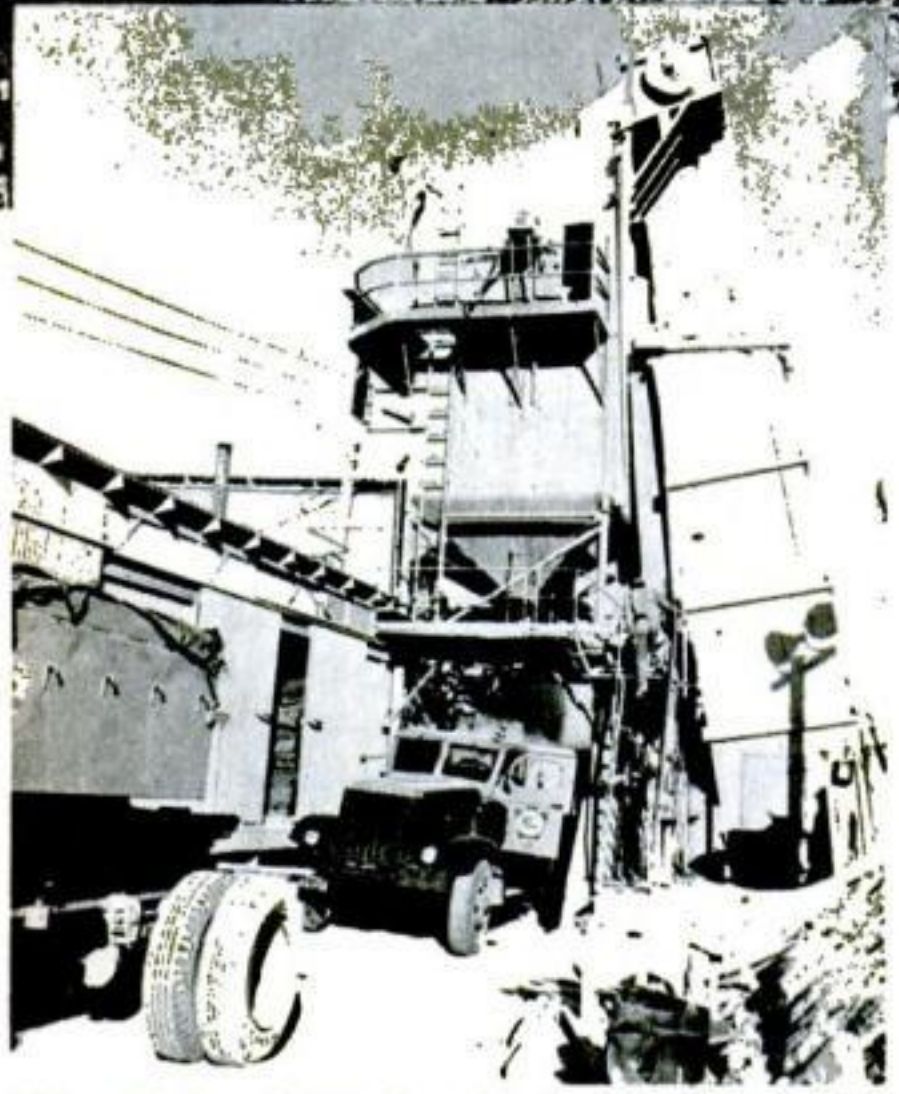
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Power shovels bite into the subsurface of Rogers Dry Lake in California's Mojave Desert to dig out the tough, dry clay that makes oil-drilling mud. A fleet of heavy-duty trucks take it to be processed.



When it arrives at the spreading area, the newly mined clay is mostly in sizable leather-hard chunks. After sunning, airing, and disking, it is ready for the final milling.



This mill then hoists the clay to a crusher, which breaks it down into powder resembling greenish-yellow flour. Trucks load it in bulk for delivery to wells within 250 miles. Otherwise clay is sacked.

tannic acid, sodium phosphate—is used. The mud is pumped into the shaft at rates up to 900 gallons a minute. As it completes its journey, sometimes miles into the earth, the cuttings it then carries are separated by gravity or screening, and most of each gallon of mud is recycled—pumped through the circuit again and again.

The Mojave Corporation began prospecting Rogers Dry Lake in 1924. Cross lines were drawn on the nearly impregnable surface every quarter mile of its 25 by 6 miles. Samples of clay were taken every foot down. One day the foreman reported to General Manager Fay Lindbergh that he had found clay so hard to break up that he had difficulty filling a sample bag.

"We'd found a mud that was really thirsty," says Lindbergh, "and the way it hung onto water was hard to believe." The new mud lost only 4½ cubic centimeters of water in a standard test. Average muds lose as much as 50.

Here was the mud that would minimize



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Under high pressure, the liquid mud is pumped through hose, shown looped at center right, into the rotating drill pipe. The mud goes down the pipe, spurts out at the bottom, cools off, and cleans the bit. Then it returns outside of the pipe.



Looking into mouth of a White County, Illinois, oil well. The rotary drilling pipe is shown in the mud-filled hole.

the driller's greatest hazards. First, there's stuck pipe. When thousands of feet of jointed pipe, to the bottom end of which is attached the drilling bit, get stuck, it takes hours, days, sometimes weeks to pull them out, rejoint them, and put them down again. Then there's cave-in. When the earth surrounding the shaft caves in, drilling is delayed. Finally, blowout. Gas or oil under greater pressure than the mud holding it down will blow up through the shaft or out through the sides. Any one of the three mishaps means heavy financial loss.

Particles of Lindbergh's mud are as small as four one hundred millionths of an inch thick. They assume electrical charges in water, with negative charges predominating on their surfaces. They repel each other, causing them to develop a "community" thirst. By chemical control, engineers regulate the degree of "jell" so that the liquid mud can suspend weight material for creating extraordinary hydrostatic pressures to restrain gas pressures deep in the earth.

The newly mined clay is hauled to a spreading ground near by, where it is sunned, aired, and repeatedly disked. When it is reduced to small clods, scrapers drag loads across a hopper where the mill hoists it to a high-speed crusher. The clay emerges from the crusher as a fine powder at the rate of a ton a minute.

The corporation's trucks travel 50,000 miles a month delivering mud. To rescue wells in trouble, a dozen trucks sometimes shuttle day and night. Last year 100,000 tons of dry mud, worth $3 a ton in bulk or up to $10 a ton sacked and delivered, was produced by Mojave.

That's real "pay dirt."



Without the right mud to hold it down, the gas pressure in a drilling well can blow out and cause damaging fires like this one at the Signal Hill field in Los Angeles County, California.



**A HAT** is put on Pepito by softening surface of his head with a hot-point iron and fusing the hat on. Body parts are joined in the same way.



**ALLURING LOLITA** and fun-loving Pepito were created by model-designer Duke Russell. Secret mixture of waxes gives natural-skin texture.



**DOLLING UP** Lolita. For close-ups, an oversize head is used so that the eyebrows and eyelashes can be handled easily by the artist.

*Photographs by*
*BOB NEWMAN*

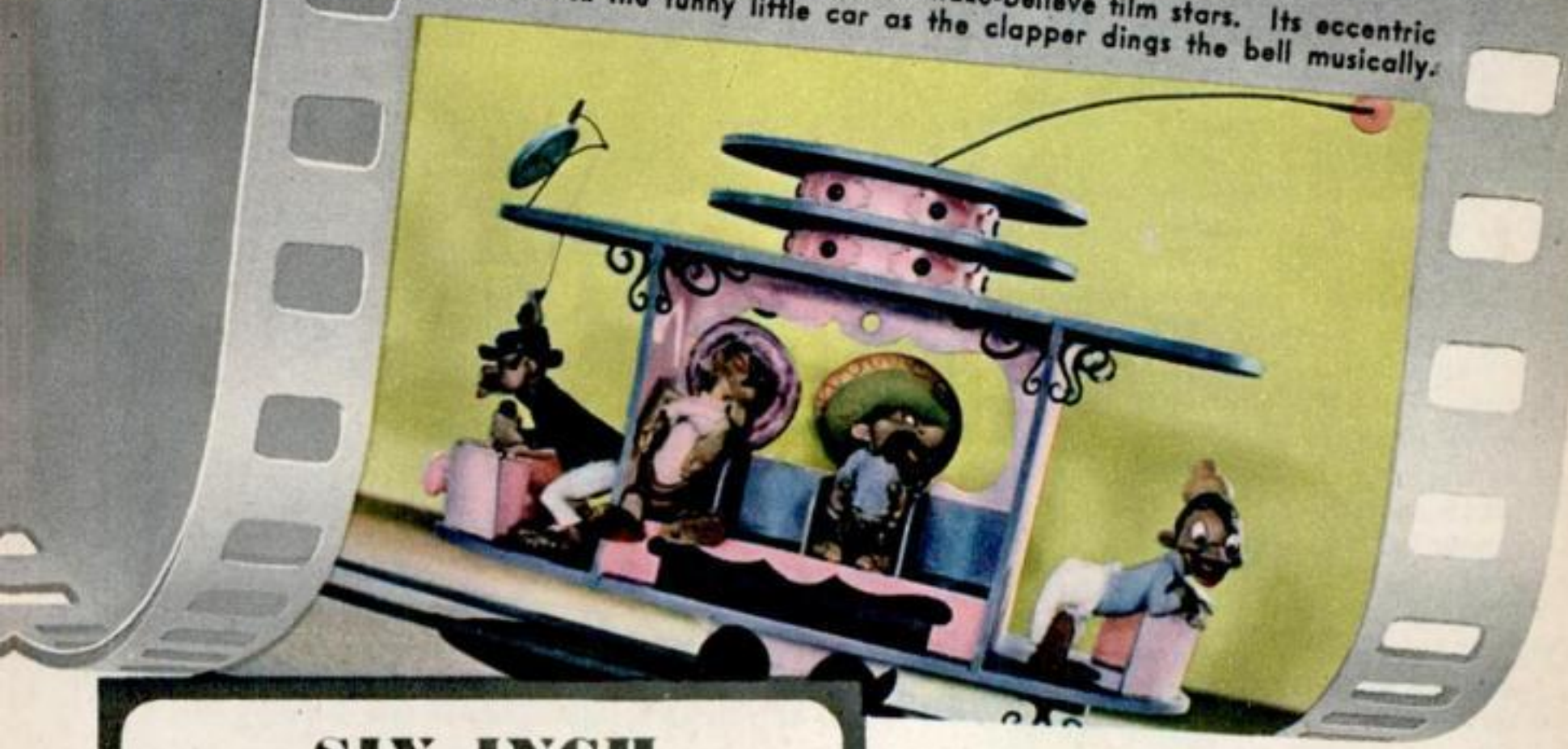
**SERENADE** by Pepito. Four of the 10 positions needed to film a single stroke on guitar.

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**PEPITO AND LOLITA,** new plastic stars of the cartoon movies, take a leisurely stroll down the street of a modernistic village in Mexico.

**BOUNCING TROLLEY** carries make-believe film stars. Its eccentric wheels rock the funny little car as the clapper dings the bell musically.

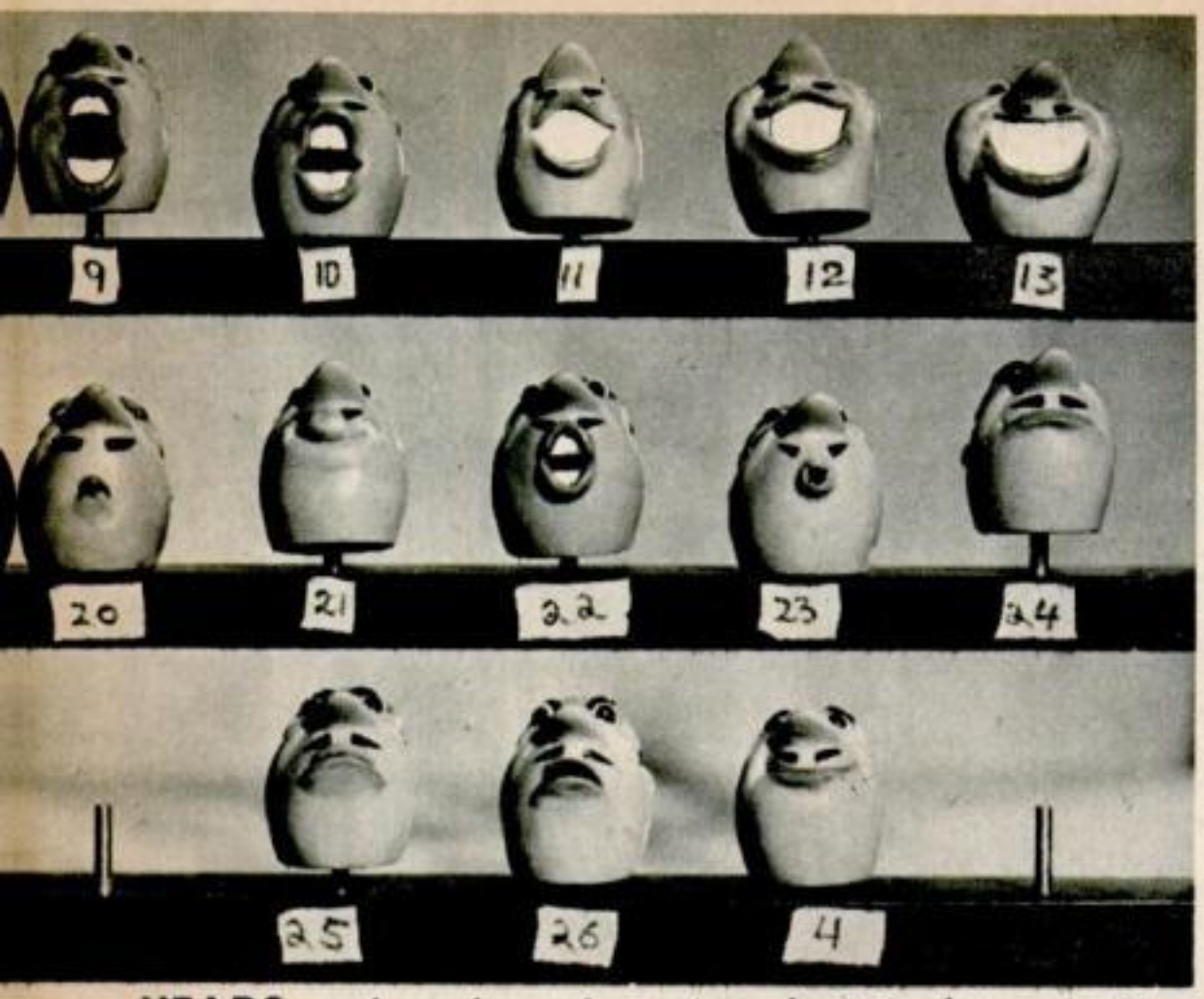


## SIX-INCH
# Wax Dolls
## ARE NEW STARS IN FILMLAND

PLASTIC cartoon figures that smile, strut, hop about or dance with joy, and can appear surprised, terrified, bored, or disgusted have given animated films a new three-dimensional look.

The "stars" of the new movie clan are Lolita and Pepito, each of whom has more than 100 heads. In addition, hundreds of hands, arms, legs, and feet are kept in readiness, for each change in body movement






**HEADS,** such as these of a waiter who is in the supporting cast of Lolita and Pepito, are kept near at hand. The director selects those needed to achieve an effect and orders by number.

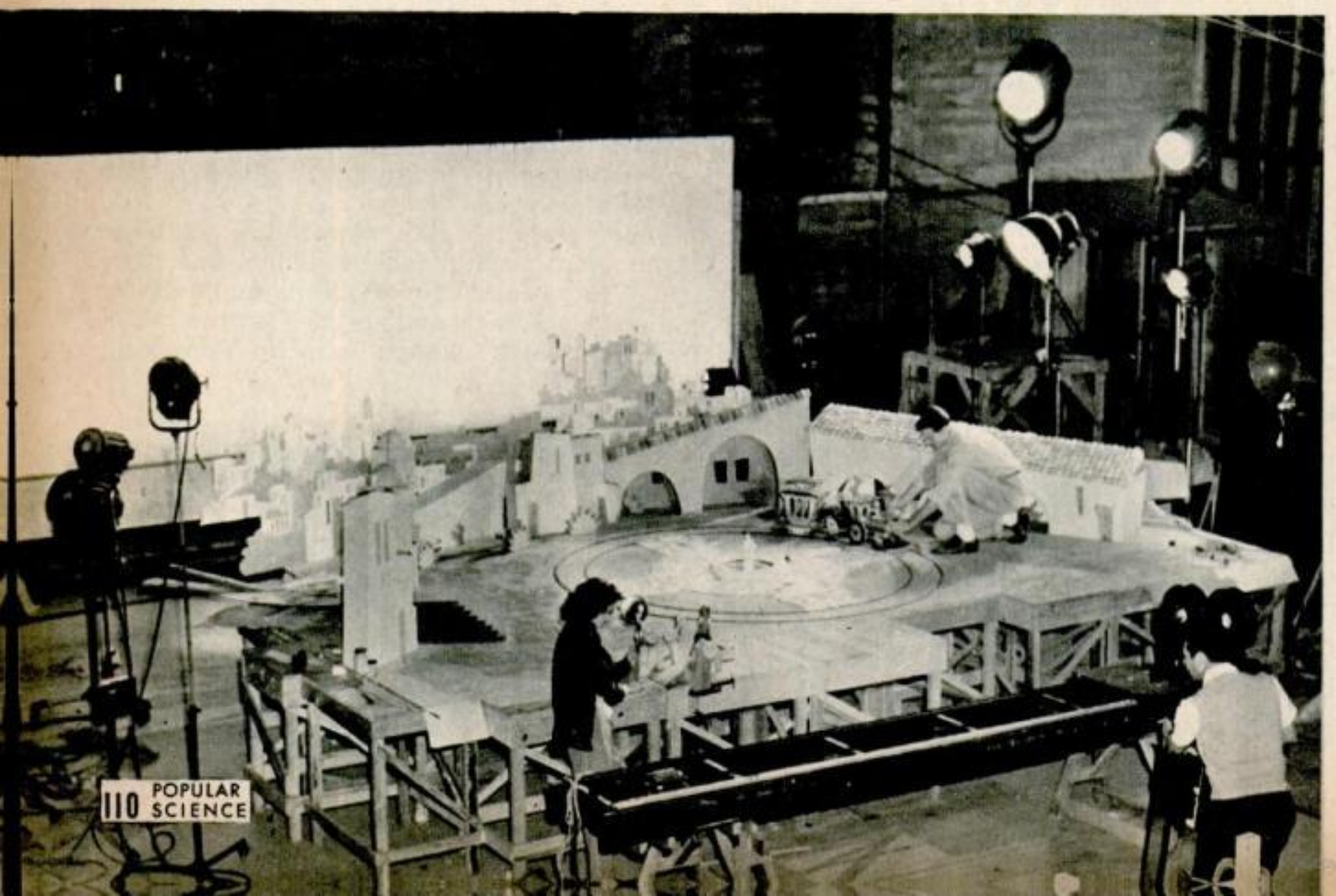
requires several individual parts to express the action. Only six inches tall, these dolls are moved around on miniature sets like those built for model railroads.

Pictures are filmed frame by frame, often with a new body position for each succeeding frame. Each figure assumes eight poses for one step forward, and is held in position by a steel pin that penetrates the floor of the set. As many as 50,000 changes of parts may be required for the 10,400 frames necessary to make a 650-foot picture that runs 10 minutes. Several score artists, animators, wax workers, set builders, and camera operators are needed to move the cast of characters through a scene.

Larry Morey and John Sutherland, of Los Angeles, producers of the plastic cartoons, make their performers out of a combination of several waxes. Body parts are formed by pouring the mixture, at a temperature of 180 degrees, F., into tiny plastic molds. Two hours later they are ready to be worked into the desired shapes and forms that make them look like real people.

The hardened wax looks so much like human skin that it doesn't have to be painted, but lips, hair, cheeks, eyebrows, and eyelashes, of course, must be added. Eight parts form each performer's body: head, neck, torso, hips, two arms, and two legs. Removable hands sometimes are used, especially in close-ups when characters must move fingers or clench fists.

**SETS** are constructed with the same care given those for major productions. Built on a diminishing scale, they present an appearance of added size and depth to the Technicolor camera at the lower right. Paper animators make flat-surface action drawings that are used as a script in guiding technicians and prop men.



# I'D LIKE TO SEE THEM MAKE...

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? Popular Science Monthly will pay five dollars for every such suggestion published.

**A "bizzy buzz"** to notify the person receiving a telephone call that someone else wants to talk to him. Maybe, says ideaman Dr. Frank Victor, Kew Gardens, N. Y., there could be a return signal saying, in effect, "Try again a little later."




**Embarrassment saver** for railroad coaches. Outside of every toilet would have lock-controlled red and green lights to indicate whether the space is occupied or vacant. Idea by A. H. Stevens, Jr., Clinton, Conn.




**Convertible outboard motor.** It could be lifted off a boat and clamped on the back of a scooter for land travel between bodies of water. Carl Gran, of Chicago, allows that water cooling is not wholly practical on a scooter and that it is not advisable to remove the propeller. He says, however, that a clutch or spline on the vertical shaft could be made to fit snugly into the drive on the scooter for quick, easy transportation to the next lake.



**Battery-heated blankets** for the use of spectators at football games or other cold-weather outdoor activities. Thus far, electrically heated blankets have been designed for house current. The idea was suggested by Pat Mullane, Kansas City, Mo.




**Dripless gravy spoon.** You could dip gravy from the dish across the table and bring it over to your potatoes without drooling a brown streak to your plate. Staff Sergeant Franklin O. McCombs, Bay St. Louis, Miss., suggested it.

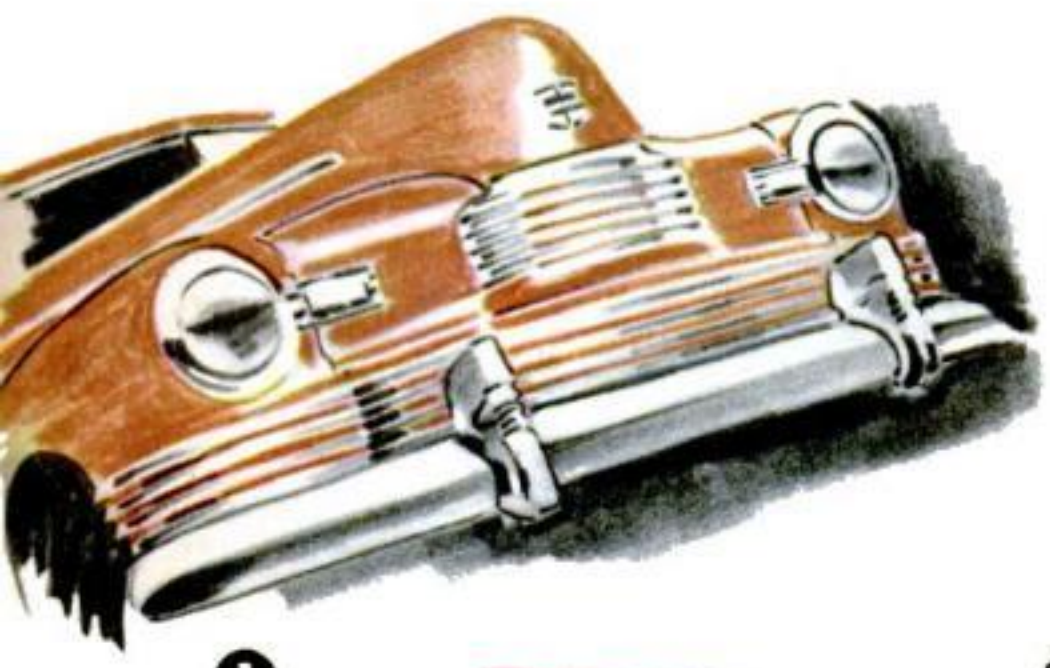





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# DO YOU KNOW YOUR

**Test yourself with these sketches by T. Madawick, industrial designer. They include distinguishing features of 11 models now on the road. Then turn to page 208**



1



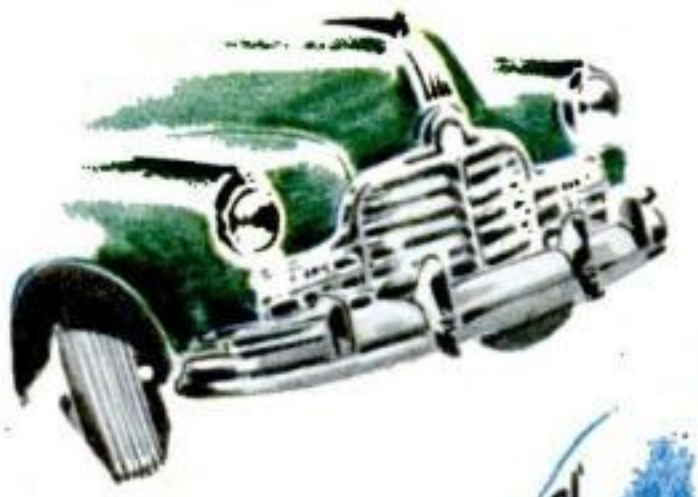
2



3



4



5



6



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# 1946 CARS?

**for the correct answers, and give yourself 10 points for every one you got right. If your total score is 120, you ought to go to the *end* of that line of potential buyers.**



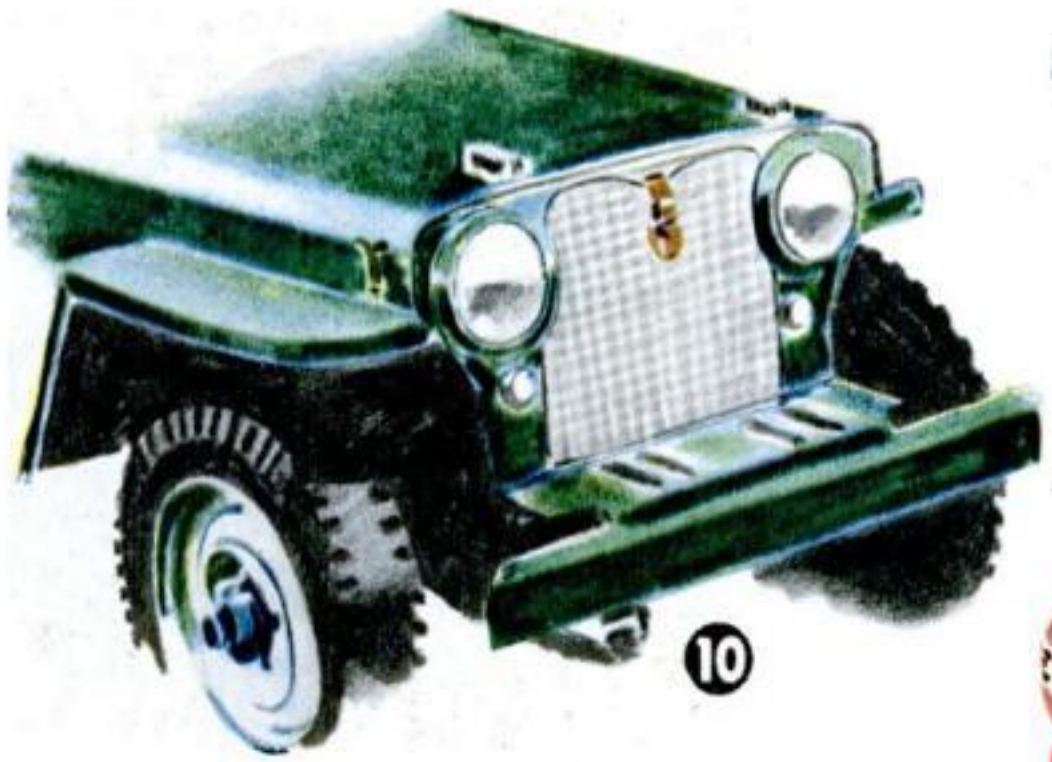
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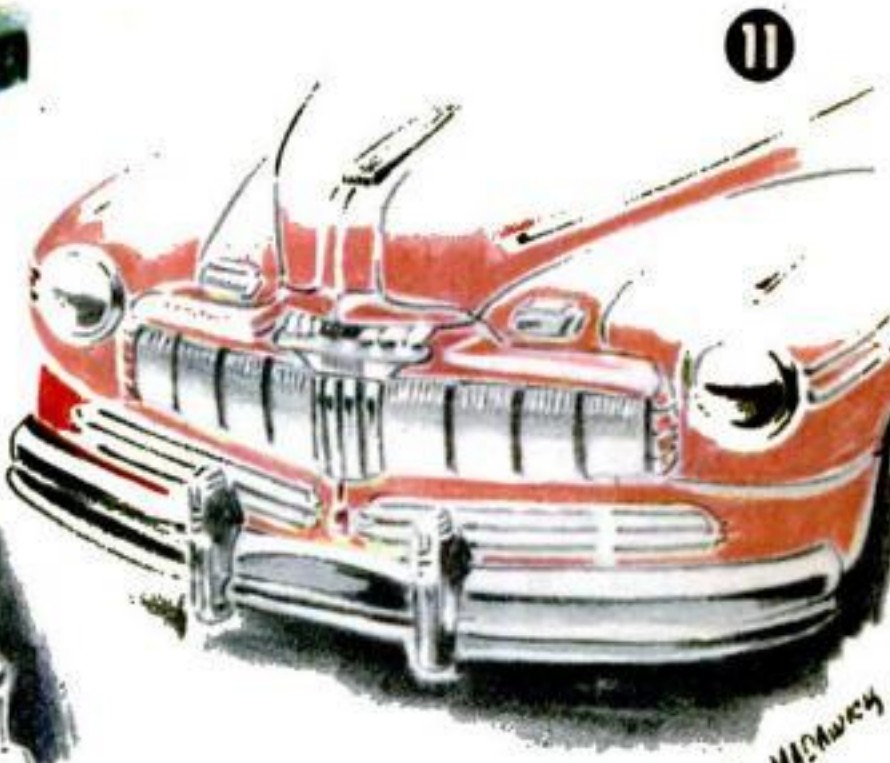
8



9



10



11



12



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This is what happens when a milk bottle falls and breaks. Instead of bursting all at once, it smashes first at the impact point, then disintegrates upward.

# Flashes of



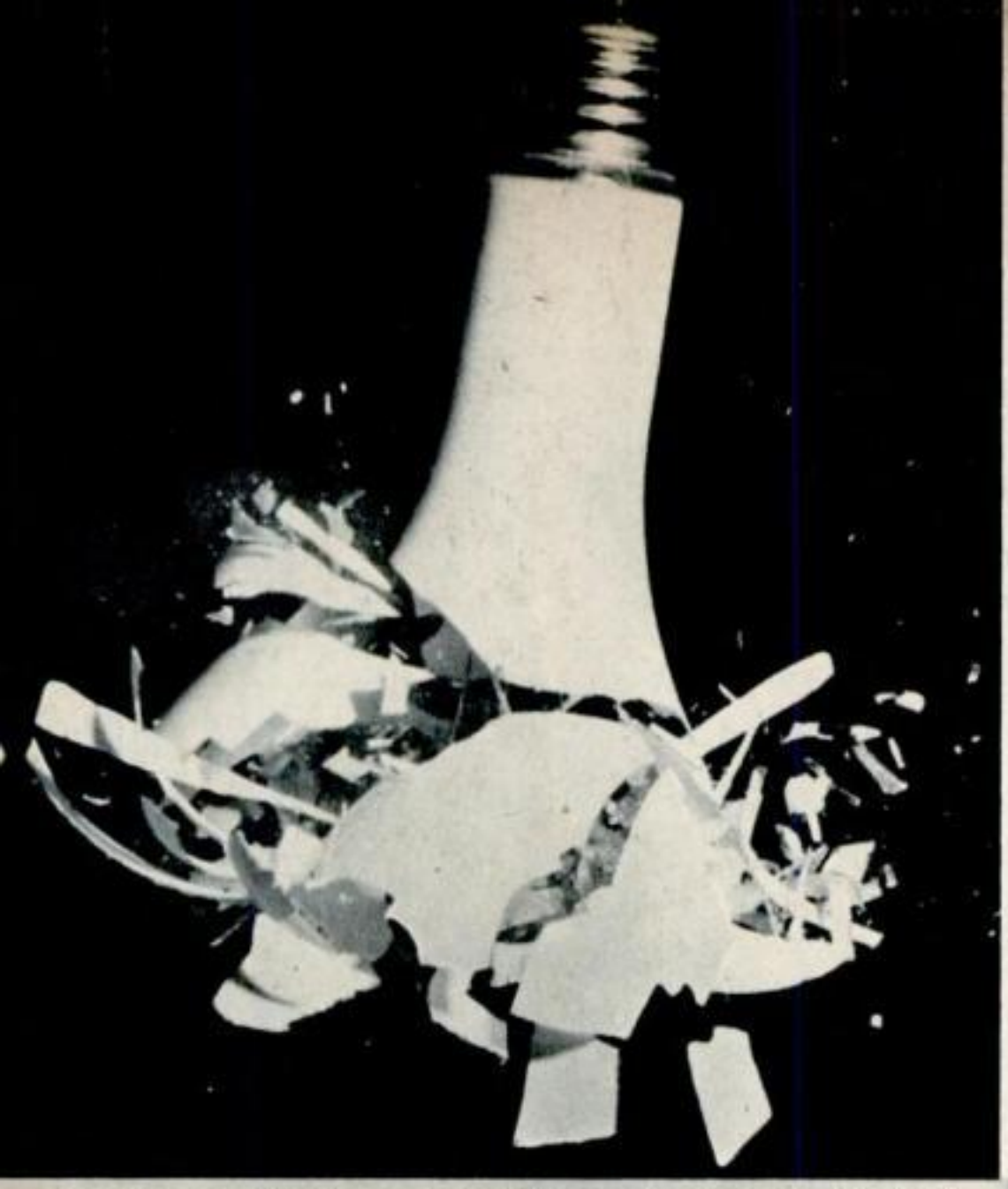
Matches took a disorderly tumble as one end of their box dropped faster than the other. Contrast in these photos was heightened by doubling development time.



PHOTOGRAPHER David McLane, of New York, set out to see what happens when you drop something and it breaks. He balanced a lead target that closed an electrical circuit when struck, tripping the shutter on his 4x5 Speed Graphic and firing a Kodatron Portable Speedlamp. The lens, a five-inch f/4.7 Ektar, was open at f/22 for 1/100 of a second, but the real exposure time was that of the lamp's flash, 1/10,000 of a second. Its battery powers 200 flashes before it needs recharging. With vibrator converter, it delivers 2,000 volts D. C.



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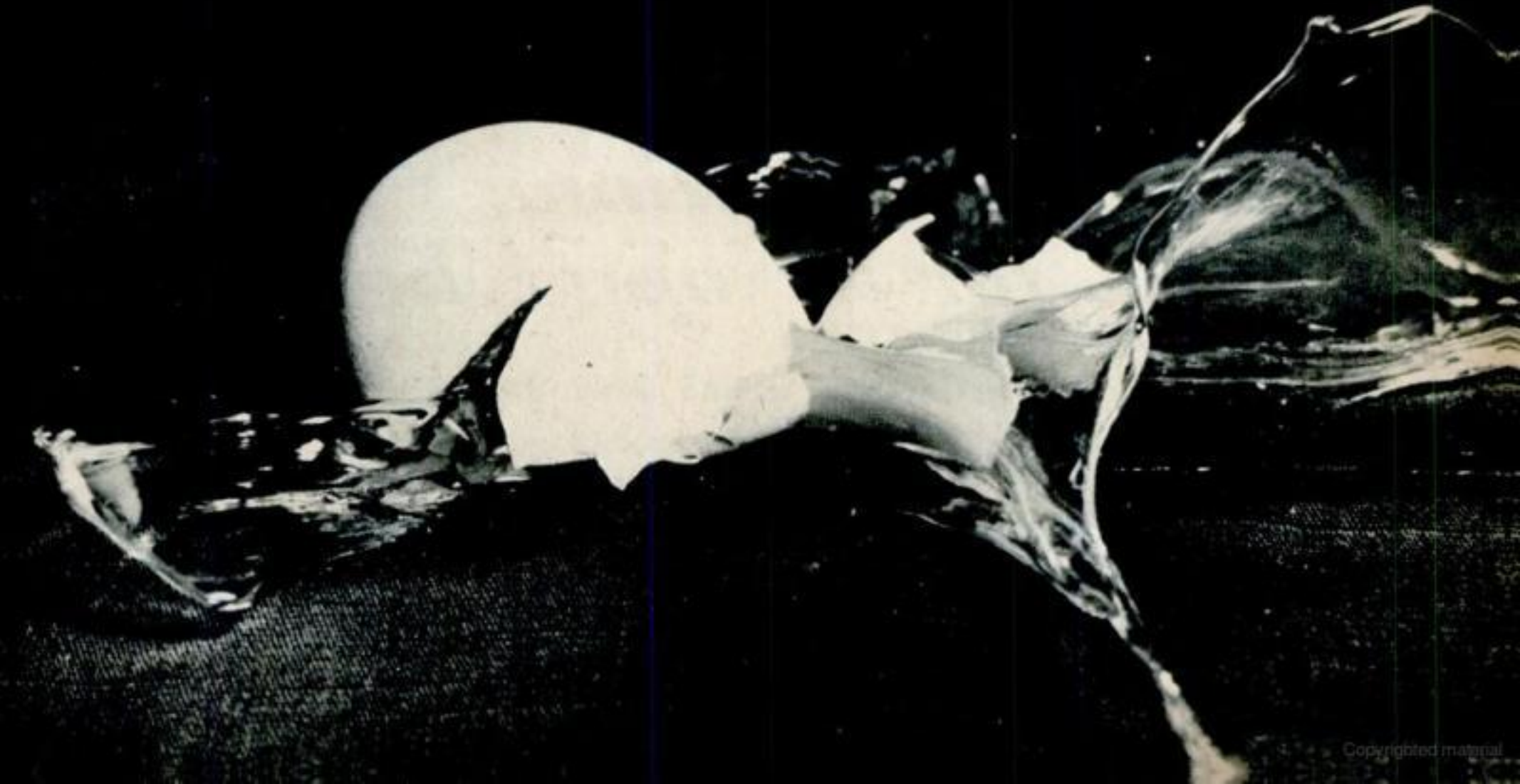
Dropped six times on the photographer's lead plate before it broke, this rare bulb then went to pieces just like the milk bottle. The lens caught it before the neck collapsed.



Is the ribbon of water spraying upward from the shattering glass or crashing downward? McLane thinks it slipped out on the way down and has not yet hit.

# Things Going to Smash

An egg breaks in two spurts. The clear glasslike sheet is the fast-spraying white. The yolk held together longer and is just beginning to fly out of the shattered shell. McLane at first tried to judge the instant of impact by eye alone, but quickly found this method was so inaccurate that he rigged up his hair-trigger switch.



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Pennsylvania Dutch originals inspired both this chest and its decorations. As the first step in the stenciling process, the sketches are drawn on plain paper. Then the parts are transferred to the stencil paper with carbon paper, as below.



Materials needed for the job include stencil paper, a sharp knife, brushes, chalk, paint, thinner, and drier. A white dinner plate makes a good palette.



# Stencil Decorations for a Hope Chest

## DIFFERENT DESIGNS WITH ONE THEME GIVE HAND-PAINTED EFFECT

**By Joseph Aronson**

STENCILING is an ancient method of simplifying the reproduction of a decorative theme. By cutting the elements of the theme out as separate stencils and then combining them in different ways, a generous variety of related, but not quite identical, designs can be created.

Decorations from Pennsylvania Dutch furniture are particularly suitable for the chest above, for its design also came from



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Symmetry and color harmony are features of this pleasing design. It is suggested for the top of the chest.



In cutting the stencil, a razor-sharp knife with a good grip is important. The easy sweeping cut that produces a flowing curve is a matter of practice.



Each unit of the design is first transferred to the work with chalk so that changes can be made until the desired spacing and arrangement are obtained.

Paint is applied through the stencil with a light stamping motion, straight up and down. The paint must be thick. If thinned too much, it will flow.

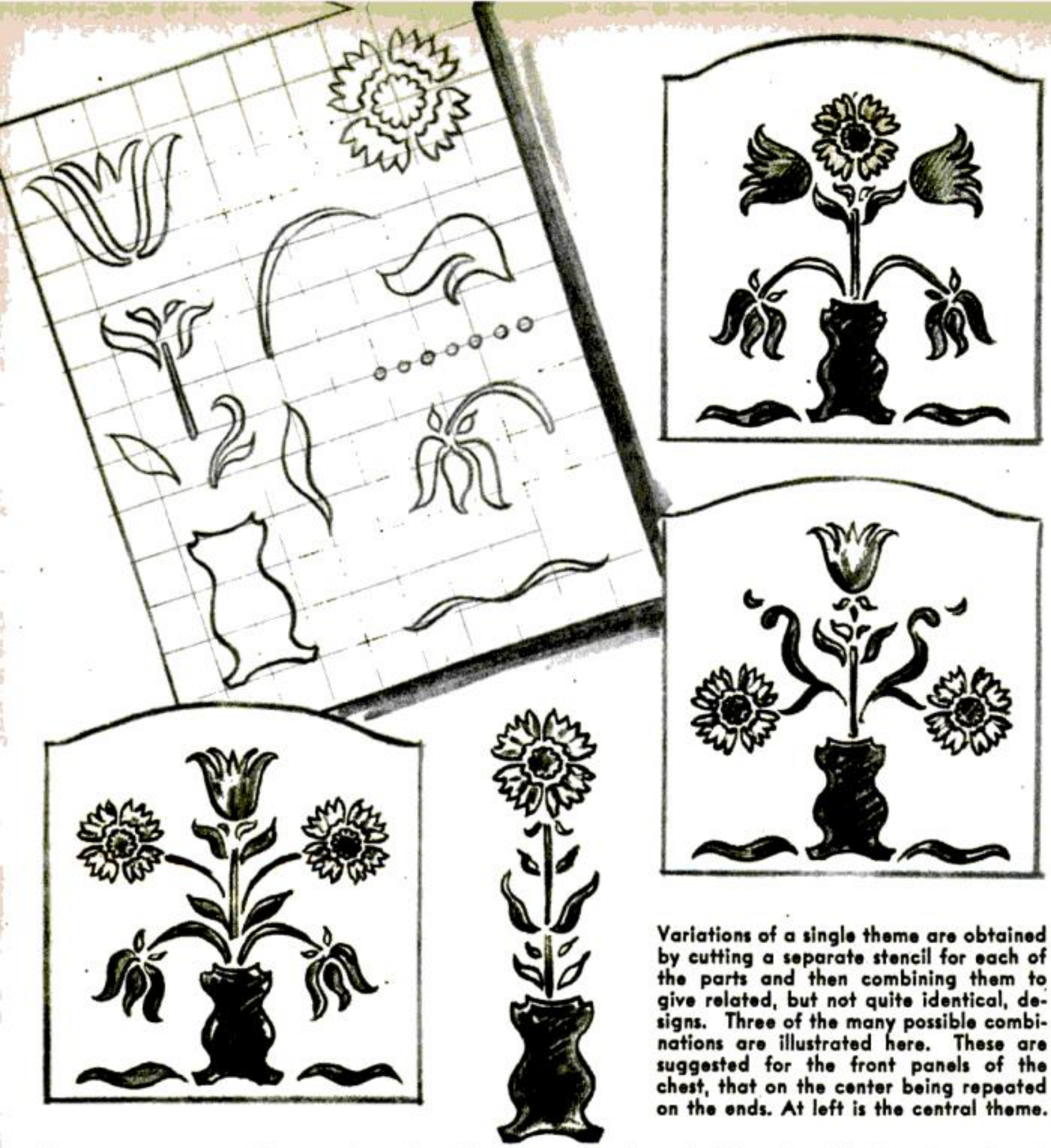


Brush lines or light touches of shading colors help tie a design together. Your own skill with a brush will tell you how much of this touching up to risk.





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Variations of a single theme are obtained by cutting a separate stencil for each of the parts and then combining them to give related, but not quite identical, designs. Three of the many possible combinations are illustrated here. These are suggested for the front panels of the chest, that on the center being repeated on the ends. At left is the central theme.

the same source. (For construction details, see P.S.M., April '46, p. 152). At the top of this page, a Pennsylvania Dutch theme has been broken down into its component parts. When made into individual stencils, these can be used to produce related designs for the top and the side and end panels of the chest. Only a small amount of freehand brush work will subsequently be required.

After sketching all the units to size on plain paper, transfer each to a stencil sheet with carbon paper, leaving plenty of margin. Two or three units can be placed on one sheet provided they are far enough apart.

Stencils usually are cut in a stiff oiled paper that may be obtained in paint stores. Your knife must be razor sharp. For flowing curves, use an easy sweeping cut and at intersections go beyond the line so that the inner part falls out without pulling.

Each part of the stencil is first transferred experimentally to the work with chalk of contrasting color. This makes it possible to judge when the proper spacing and arrangement have been obtained. The chalk can be rubbed off when the paint dries.

Thin the paint to the consistency of thick cream with a little Japan drier and a bit of turpentine. Be careful not to get the paint too thin or it will flow under the edges of the stencils.

The stencil brush should have straight stiff bristles, and a stippling motion should be used. Never attempt to spread or flow the paint. If you do not have the proper brush, a pad of velvet or felt can be used in the same way. It is well to do all of one color at one time, and let it dry thoroughly before applying another. Clean the stencils frequently to prevent smears.



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# NEW TOOLS

## All-Steel, 90-Foot Conveyor Speeds Assembly of Radios

AN ALL-STEEL conveyor, 90 feet long, has been installed in the plant where Motorola radios are made. Its perfectly flat surface, consisting of a series of plates linked together in such a way that their operation is practically noiseless, speeds the process of assembling and inspecting sets. The Steel Parts Mfg. Co., Chicago, built it.

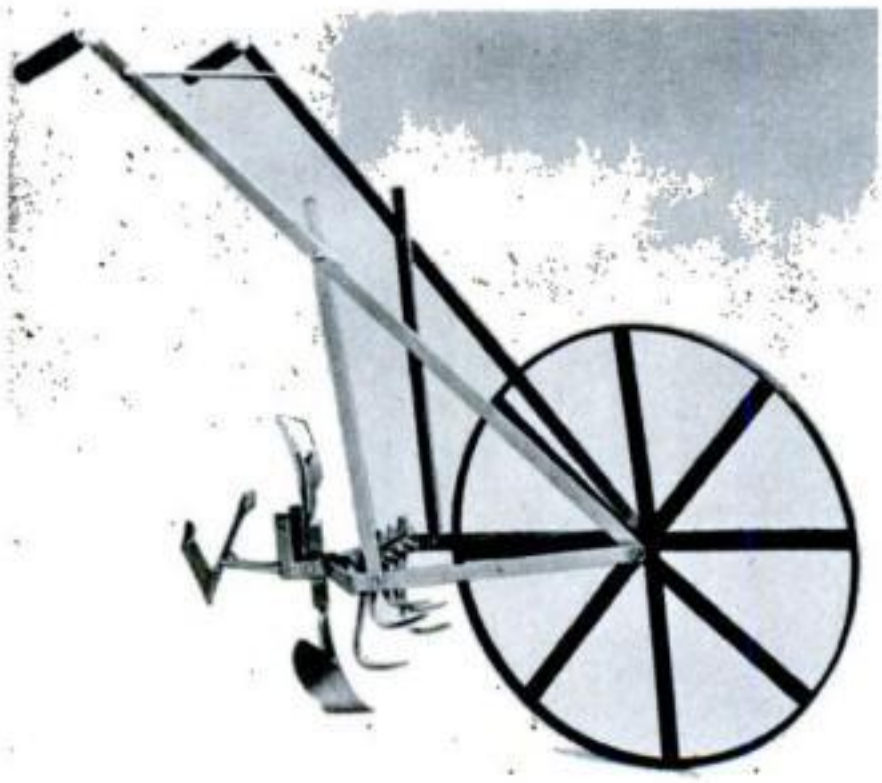


The quiet operation of the "Steelok" conveyor tends to lessen nervous fatigue in those who work at it.



## Gauges Curved Glass

CURVED sheets of glass and transparent plastics now can be gauged accurately with an Aireon Optical Micrometer. It is a microscope with a plastic nosepiece, which is held against the sheet to be measured. When the microscope has in sharp focus a mark on the other side of the sheet, the thickness of the sheet can be read on the micrometer's scale.



## Hand Cultivator Enables User To Change Tools with Foot

GARDEN farmers can accomplish most of their ordinary chores with a Suburban Jones hand cultivator, without a tedious delay for changing tool adjustments. This cultivator, made by Aircraft Mechanics, Inc., Colorado Springs, has four built-in tools on a rotary unit. The user can select the one he needs with his foot; each tool automatically locks in working position.

## Automatic, Adjustable Wrench Keeps Constant Grip on Nut

THE jaws of the adjustable Larc-o-matic wrench, produced by the O. W. Hedstrom Corp., of Chicago, keep a constant grip on square, hexagonal, metric, and odd-sized nuts while the handle is being moved. The wrench automatically ratchets and secures a 1/4, 1/6, 1/8 and 1/12-turn grip for close work. It is available in six-inch, eight-inch, and 10-inch sizes.

Ten-inch size of the Larc-o-matic wrench opens 1⅜ inches.



The wrench is shown in an open position here, before pressure is applied to hexagonal nut.



By a simple movement of the thumb-trigger adjustment, wrench's jaws are firmly closed.





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# Junior Edition of Mustang

ITS wings and tail assembly patterned after the famed P-51 Mustang fighter, North American Aviation's new low-wing private plane, the NAvion 4, carries four persons comfortably. Used as a miniature transport, it can haul 700 pounds of cargo in its spacious fuselage.

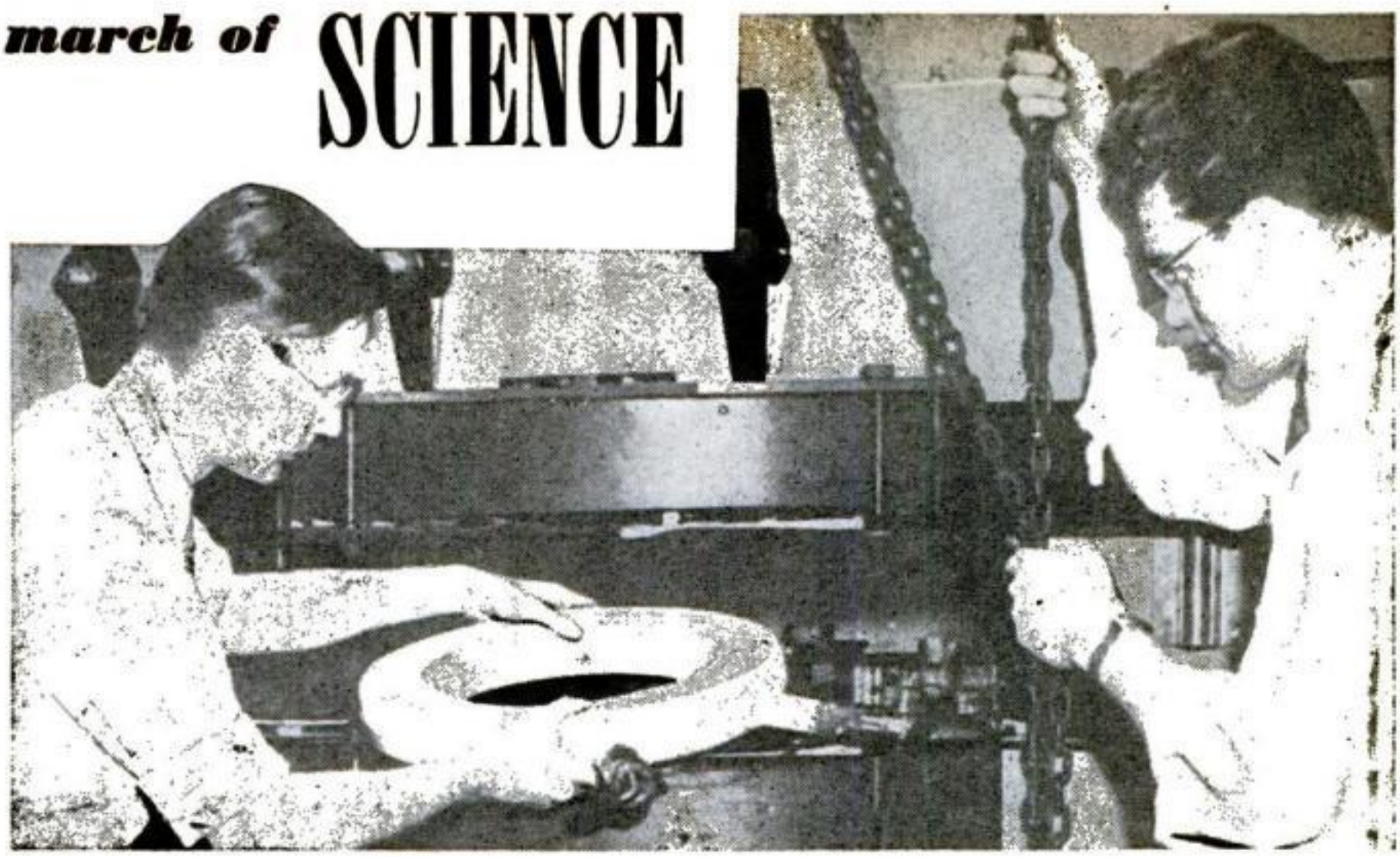
This newcomer to the personal-plane field is powered by a 185-horsepower, six-cylinder Continental engine that can pull the ship up to a ceiling of 16,500 feet. Its gross weight is 2,500 pounds, and its tank capacity of 40 gallons of fuel gives the ship a range of 506 miles cruising at 152 m.p.h. All landing gear is retractable.

The large, roomy cabin section is handsomely finished in two-tone upholstery, has a heater, and is furnished with a rear-view mirror and ash trays. Not unlike an automobile body, the cabin has a full-vision windshield, side windows, and a rear panel.

The NAvion 4 is tentatively priced at $6,250.



# *march of* SCIENCE



## Betatron Gets Porcelain Tube

PROF. Donald W. Kerst (above, left), inventor of the first successful betatron, places a new porcelain vacuum tube into the machine that can locate flaws as small as one eighth of an inch in a huge piece of steel and can examine the interior workings of machinery enclosed in metal housings. The doughnut-shaped tube produces 20,000,000 X-ray volts that can penetrate steel 20 inches thick. Assisted here by Gail D. Adams, a fellow University of Illinois physicist, Prof. Kerst is now designing a betatron that will produce more than 250,000,000 volts of X-ray energy to be used for laboratory research in cosmic rays.

• • •

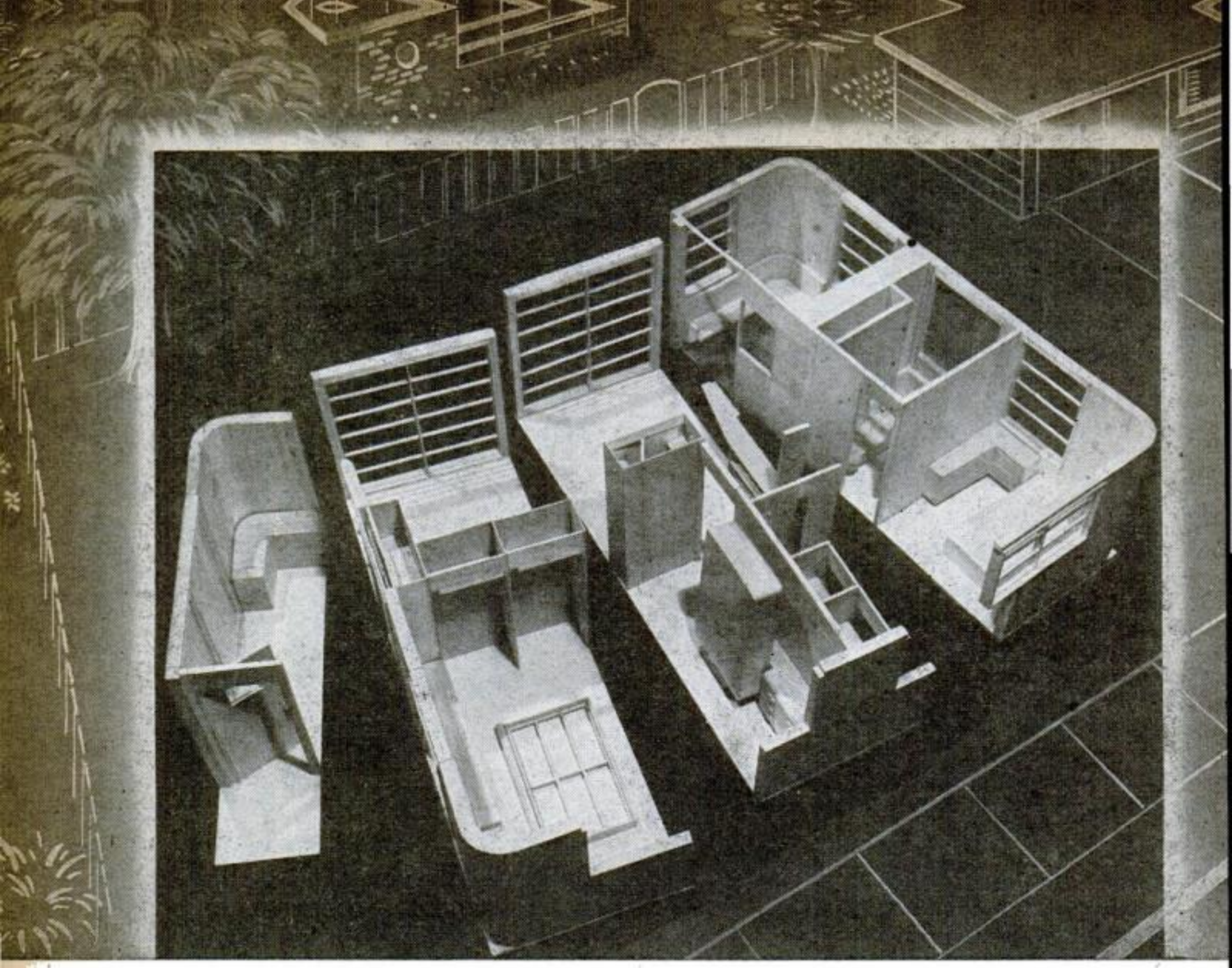
## Neptunium Poses for Picture

THE scientific pin-up below spotlights 10 micrograms of pure neptunium dioxide superimposed on a 10-cent piece (magnification, fortyfold). This man-created element is an essential link in the production of the atom bomb. The black portion to the right of the tear-shaped bead of the capillary tube is the neptunium, which would have to be multiplied 250,000 times in quantity to weigh as much as the dime. Neptunium, actually dark brown in color, is created in the atomic pile from a neutron bombardment of uranium 239. Next in the chain is plutonium, the atom-bomb explosive.





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# Plastics go BIG

## The Atmosphere Molds

By GOLD V. SANDERS

PLASTICS products bigger than a barn door are now being turned out almost as easily as an ash tray. "There is no reason," says Egmont Arens, noted industrial designer, "why even a 50-foot boat cannot be built by the same techniques." Those techniques are based on low-pressure molding, a process developed during the war and now becoming more directly important to civilians.

The new methods do not supplant older ways of forming plastics but they are widening the uses to which synthetic resins can be put. Larger molded articles can be produced and reinforcing materials can be combined with plastics to make stronger end products.

Chemists took the first step when they created new synthetics capable of being "cured" without resort to the very high pressures and temperatures required for other molding methods. Engineers then found ways to take advantage of these properties. It was done first in the airplane industry.

The pressures employed to mold many of the common plastic articles we see around us run to thousands of pounds per square inch. Such force is needed to set up the polymerization or hardening process in the material and drive the plastic into every recess of the mold. Hydraulic presses to generate these pressures and alloy steel molds to withstand them are costly, and a cabinet for a table radio is about as big an article as it is ordinarily economical to produce in these ways.

The newer synthetic resins will "set" at pressures next to nothing and at room tem-

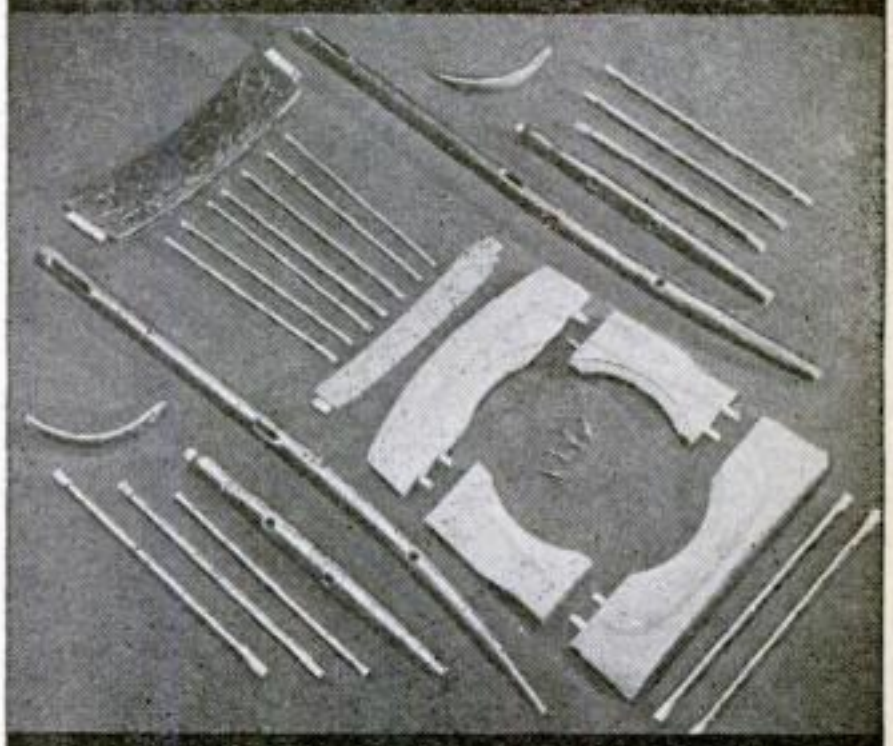


PLASTIC HOUSING UNITS already have been designed by Henry C. Carney, New York aviation engineer. Rooms can be shoved together as shown here when walls and floors are made of plastic-impregnated wood, paper or cloth, sandwiched between faces of plywood and molded by low-pressure methods.

*Illustration by LESTER FAGANS*

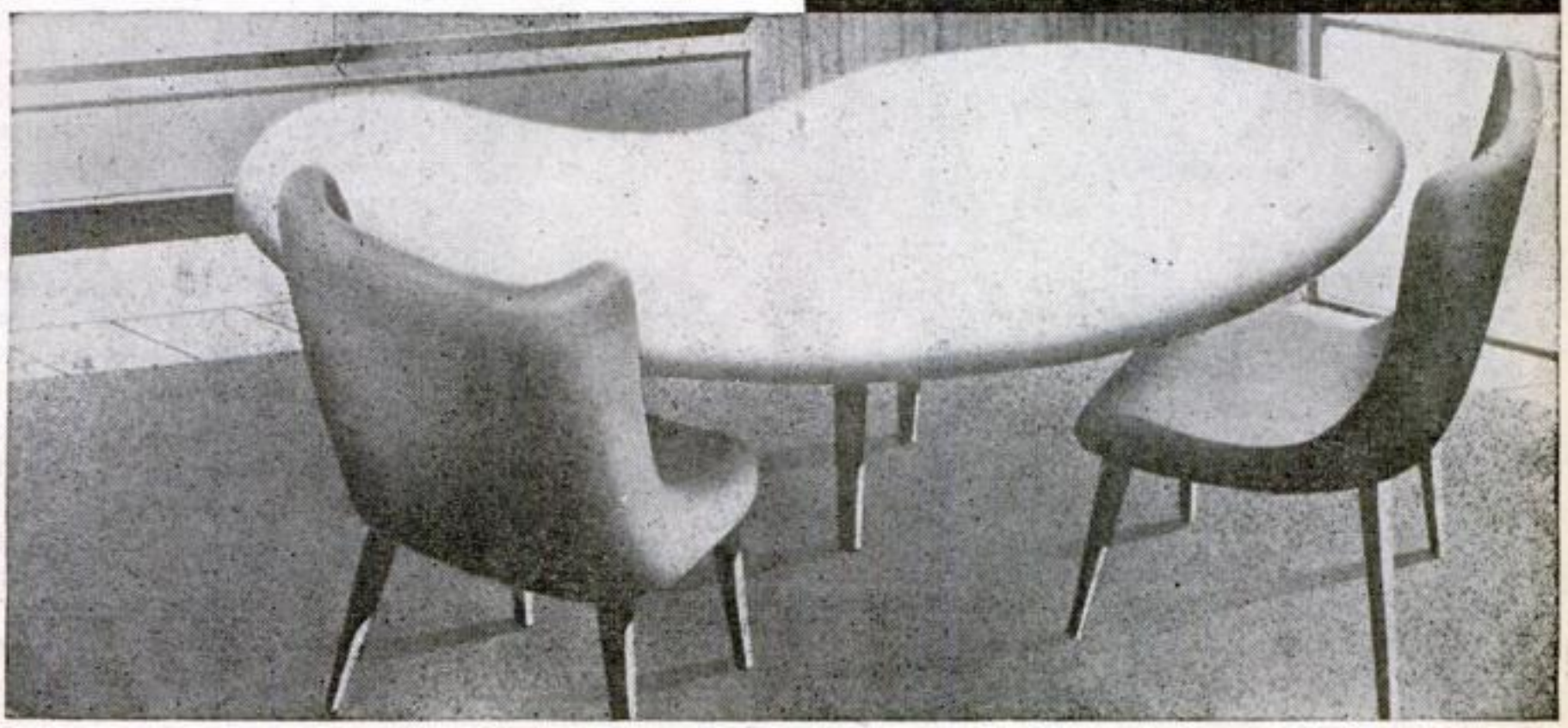


A chair of combination plastics, easily molded, has only three parts, in contrast to the many in an ordinary wooden chair, shown disassembled below.



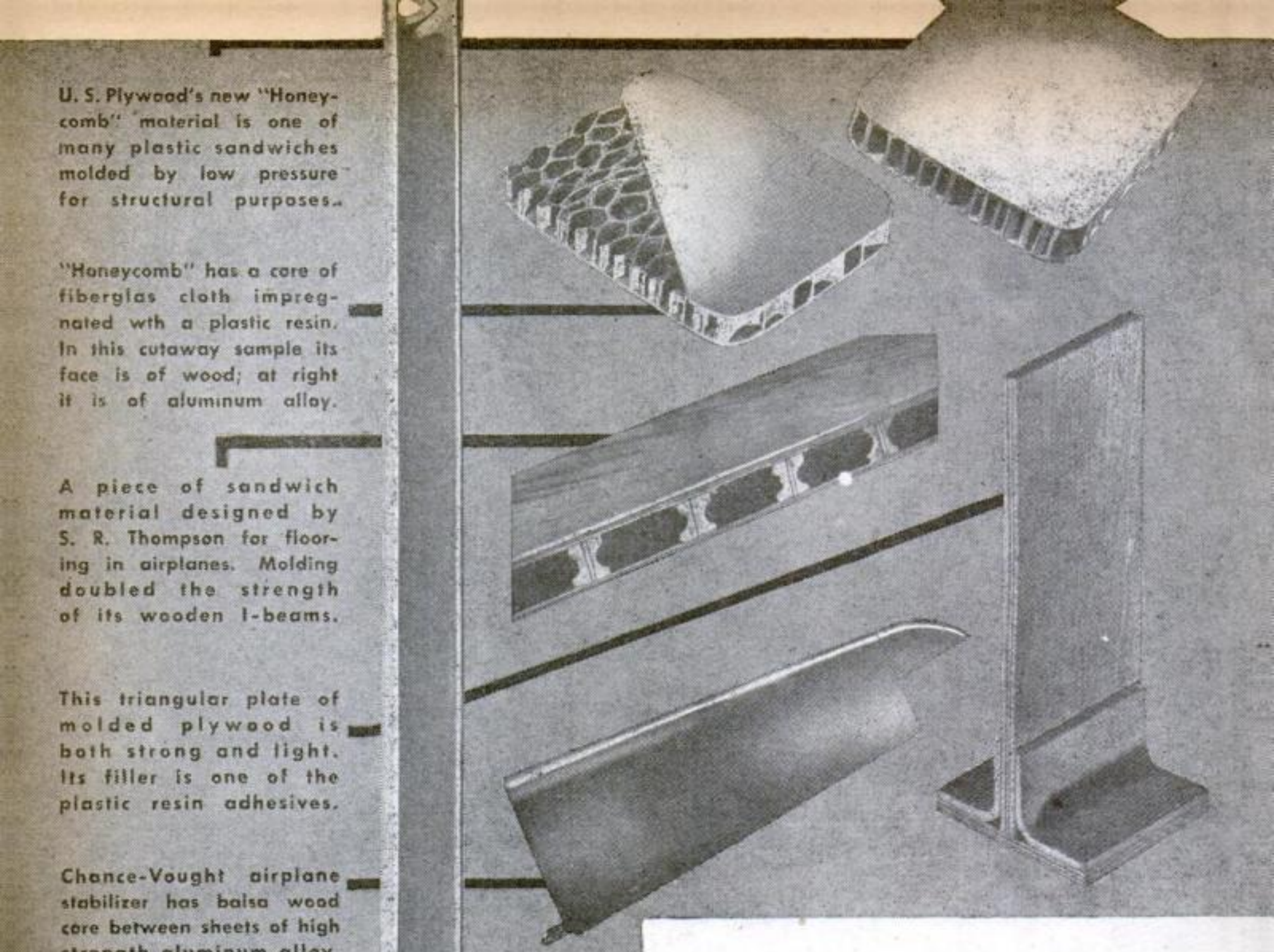
Body-fitting lines, which mark a suite of furniture (below) designed by Egmont Arens, are easily transferred to combination plastics under a small amount of heat and pressure. Arens predicts immense growth for low-pressure molding.

## New Materials into Homes.





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U. S. Plywood's new "Honeycomb" material is one of many plastic sandwiches molded by low pressure for structural purposes.

"Honeycomb" has a core of fiberglas cloth impregnated wth a plastic resin. In this cutaway sample its face is of wood; at right it is of aluminum alloy.

A piece of sandwich material designed by S. R. Thompson for flooring in airplanes. Molding doubled the strength of its wooden I-beams.

This triangular plate of molded plywood is both strong and light. Its filler is one of the plastic resin adhesives.

Chance-Vought airplane stabilizer has balsa wood core between sheets of high strength aluminum alloy.

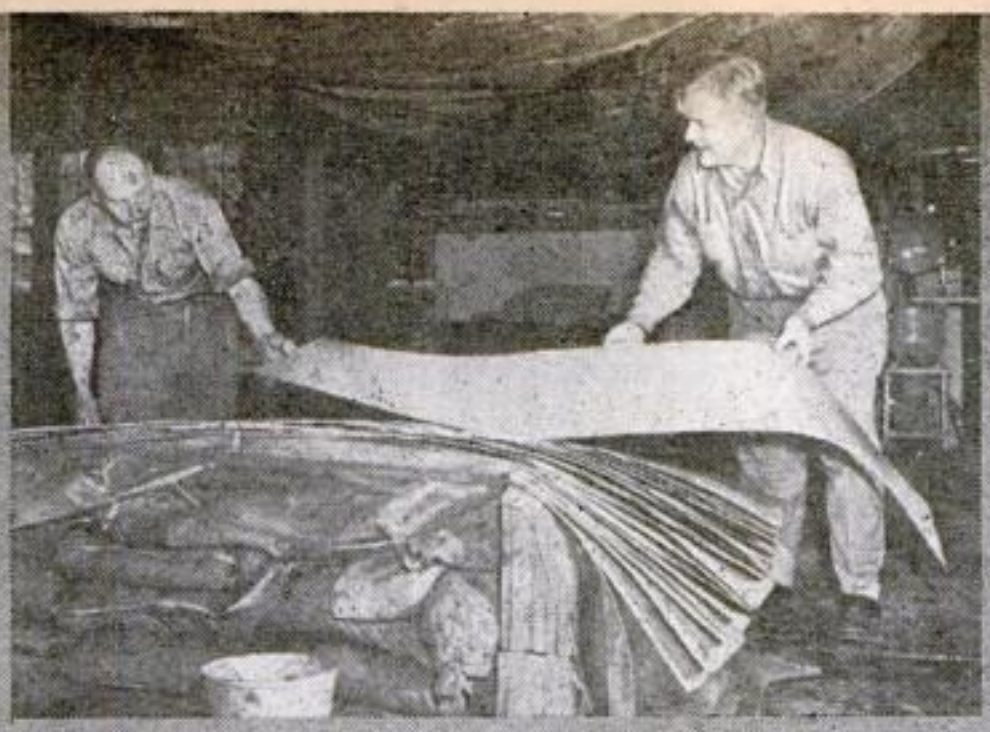
Huge structural part for airplanes is one of many turned out during the war by low-pressure molding.

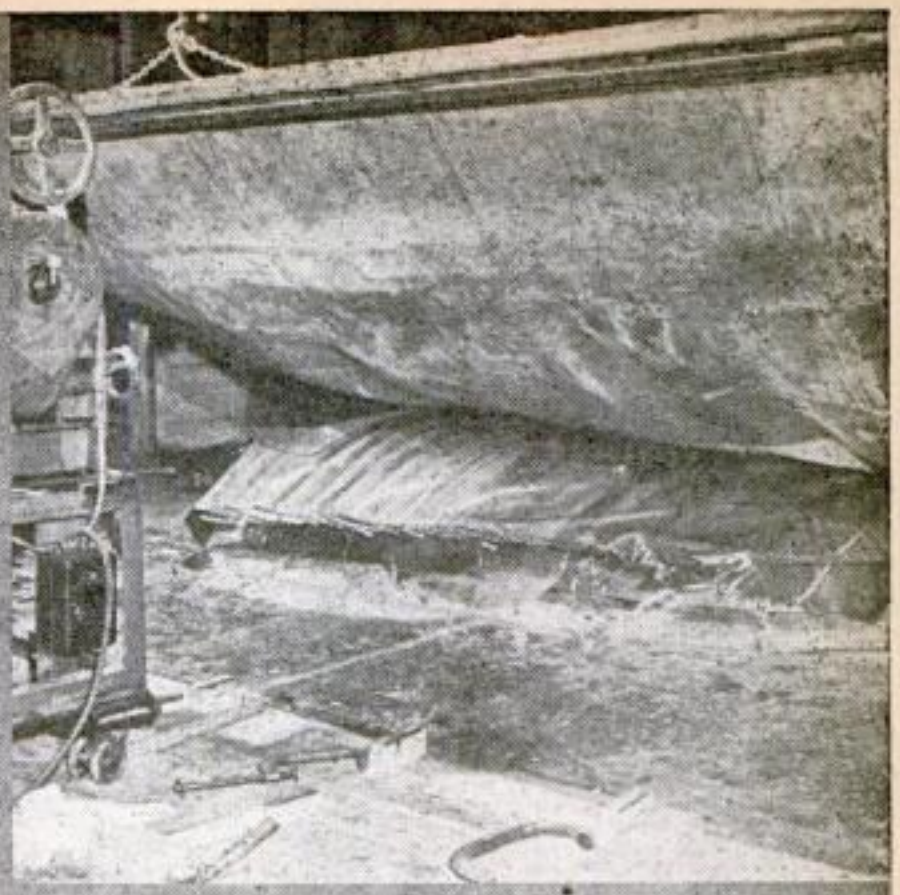
perature. The atmosphere's pressure, less than 15 pounds per square inch, is enough to set these resins, and a vacuum process, involving a heavy rubber bag, has been developed to utilize it. This process and another, which requires pumping air into the rubber bag, are both diagramed on page 126. Heat is commonly applied by pushing the assembly into an autoclave, a steam chamber that can be sealed like a home pressure cooker.

Rubber blankets are used, too, both in autoclaves and otherwise, to hold pressure or create a vacuum. There are almost limitless ways, in fact, of molding the new sensitive resins. Hydraulic and mechanical presses and clamps of various kinds are employed, depending upon the size and shape of the article to be formed. Heat is sometimes supplied by batteries of infra-red lamps, hot air in large ovens, or steam jackets.

Just as the methods of forming are simpler and less critical in low-pressure molding than in other types, so are the molds used. Instead of alloy steel, they are made of wood, sheet metal, plastics, plaster, cast metal, and even concrete. Because the heat and pressure they are subjected to are not great, such materials serve very well. When rub-

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1. Workmen above lay strips of veneer, slightly lapped like shingles, over a mold. This is a step in the Lap-Ply process, invented by Eugene O'Hare, Casein Corp. technical director.

2. A rubber blanket (top right) is lowered over veneered mold of a deck cover. The blanket is made airtight and a vacuum is created, forcing veneers against mold.

3. Electric heating pads, laid on the blankets quickly "set" the plastic adhesive between plies of wood. The finished deck cover (right) is entirely without seams.



ber blankets or bags are used, they become virtually one side of the mold, thus avoiding the expense of making a matching pair of molds.

There are as many ways of combining the materials used by low-pressure molders as there are ways of molding them. The synthetic resins are reinforced with wood, paper, fabrics, vegetable fibers such as sisal, fiberglas, and even metal. The resins generally make up less than half of the low-pressure product, the rest being the cheaper reinforcing materials. Such reinforcing material cannot well be used in compression or injection molding.

Combination plastic products are like reinforced concrete in that each material adds strength to the others when they are combined. The combined material is extremely strong for its weight. This doubtless is why the aviation industry pioneered the low-pressure techniques and largely developed them so far. Aviation engineers have produced a great many airplane structural parts of plastics that proved stronger for their weight than anything else that could have been used. Whole airplanes, such as the British Mosquito bomber, have been made of wood veneer bonded with plastics.



There are no seams in the one-piece, 8-foot dinghy above, built of sisal by the Abbott Boat Co. It weighs 80 lbs.

Streamlined housings of all kinds—radomes, antenna covers, jettison fuel tanks—have proved to be strong and efficient while saving weight to an important degree.

Low-pressure methods have given birth to a variety of "sandwich materials" suitable for structural members wherever lightness with strength is essential. In the Mosquito bomber, the filler of the sandwich is balsa wood, with laminated wood veneer skins bonded to it with plastic. Other sandwiches have cores of corrugated paper or cloth that become surprisingly strong when impregnated with resin. Engineers have tried using a new plastic "foam" for a sandwich filler that gives promise of still greater saving in weight. This plastic sponge weighs only about one seventh as much as cork.

The faces of these sandwiches are made of wood, sheet metal, or impregnated cloth and paper, laminated and cured. They need not even be of the same material. A metal face can be used on one side and wood on the other.

Sandwich material would seem to be well adapted to the building of lightweight prefabricated houses—for walls, floors, ceilings, partitions and roof. Henry C. Carney, an aviation engineer of wide experience, has designed a small five-room house to be fabricated of such sandwich stuff with a filler of corrugated paper. The house would be made in four parts, each light enough to be trucked to the building site.

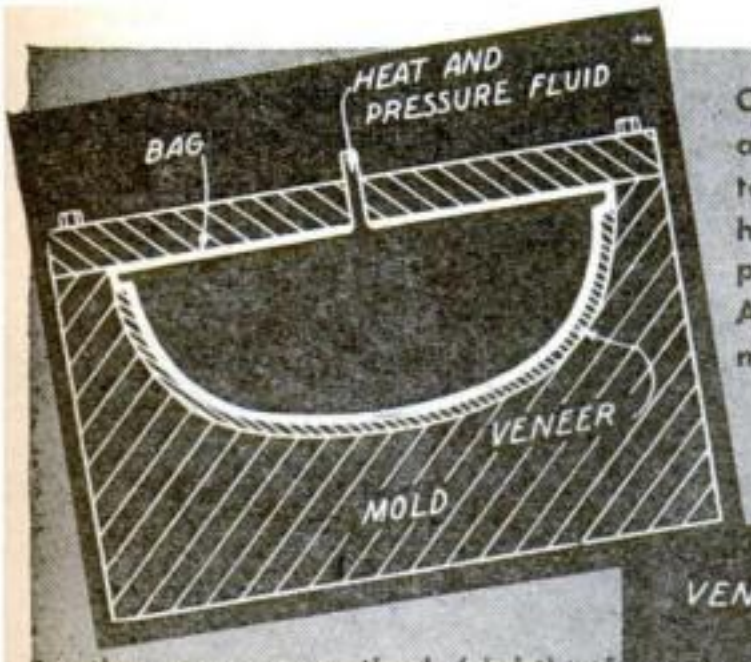
How cheaply such houses can be built and how satisfactory they will be remains to be seen. But if we are to have a plastic house it will surely be made by low-pressure molding techniques. Synthetic-resin adhesives much like those used in these molding processes are the magic ingredients in exterior plywood, now being employed in outdoor construction of many kinds. These glues are the first genuinely waterproof adhesives. They are plastics from the same phenolic base as your telephone handset.

The low-pressure molding industry is converting to civilian production. The first nationwide conference of its technicians was recently held in Chicago. Experts comparing notes there found that the following products of low-pressure molding are now being produced or soon will be: Prefabricated homes, furniture, luggage, caskets, boats, instrument cases, doctors' kits, radio cabinets, table tops, wall paneling, plywood surfacing, back panels for refrigerators, doors, artificial limbs, instrument housings, window sashes and frames, drainboards, serving trays, football helmets, aircraft parts, ice dispensers, solid sheet roofing, radar housings, and electronic insulation.

Egmont Arens predicts that within five years the low-pressure molders will use a far greater tonnage of plastics than the high-pressure fabricators, dominant until now.

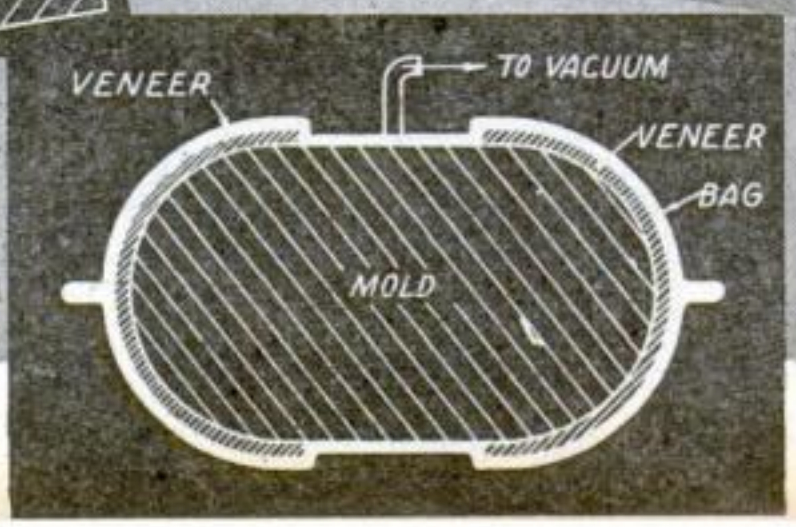
Four types of molded boats displayed at the convention all had continuous skins—no seams to calk. Boat builders are somewhat ahead of other manufacturers because they turned out such craft for the Army and Navy during the war. Plywood boats are products of low-pressure molding. Others are made, all in one piece, of impregnated duck, sisal mats, and various combinations of plastic-impregnated materials. All are strong, durable and seamless. The boat-makers are trying to cut costs and are constantly working on new techniques.

For many small articles that are better made of plastics than any other material, high-pressure molding still is more economical, more automatic. The same is true of the extrusion method, which produces another horde of plastic items. But low-pressure molding, the youngster of the family, seems to be a lad with a brilliant future.




One way (left) to mold in an autoclave (steam chamber) is to put a rubber bag inside a hollow mold lined with the plastic material to be formed. Air forced into the bag holds material in place for curing.






In the vacuum method (right) of autoclave molding, the rubber bag is laid over both plastic material and mold. Vacuum is then created in the bag, drawing it inward.

This gunner's seat is made of laminated cloth, impregnated with one of the low-pressure molding resins. It is as strong as sheet metal and weighs much less.

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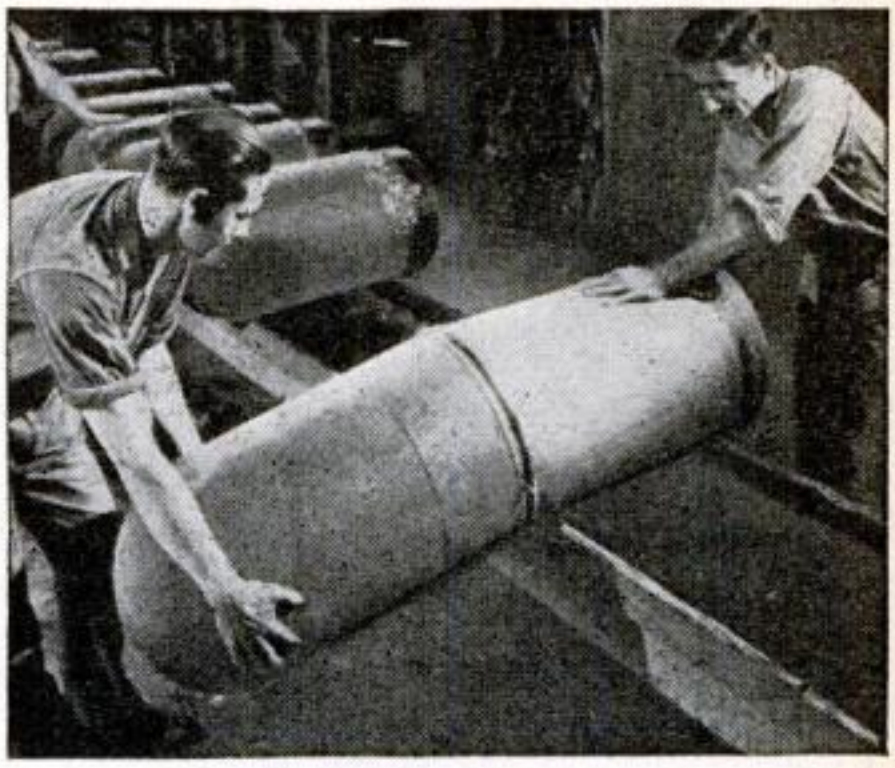
**1** Fiberglas cloth and synthetic resin made radar covers (radomes) during the war. Girls here fit cloth to a mold.



**2** Pouring the "syrup." An exact amount of plastic varnish is spilled over the fiberglas "sock" after it has been fitted.



**3** A batch of radomes is shoved into an autoclave, where they will be cooked into solid, rigid, very strong pieces.



**4** When the radome comes out of the autoclave, cured, it is removed from the mold by blowing compressed air inside.



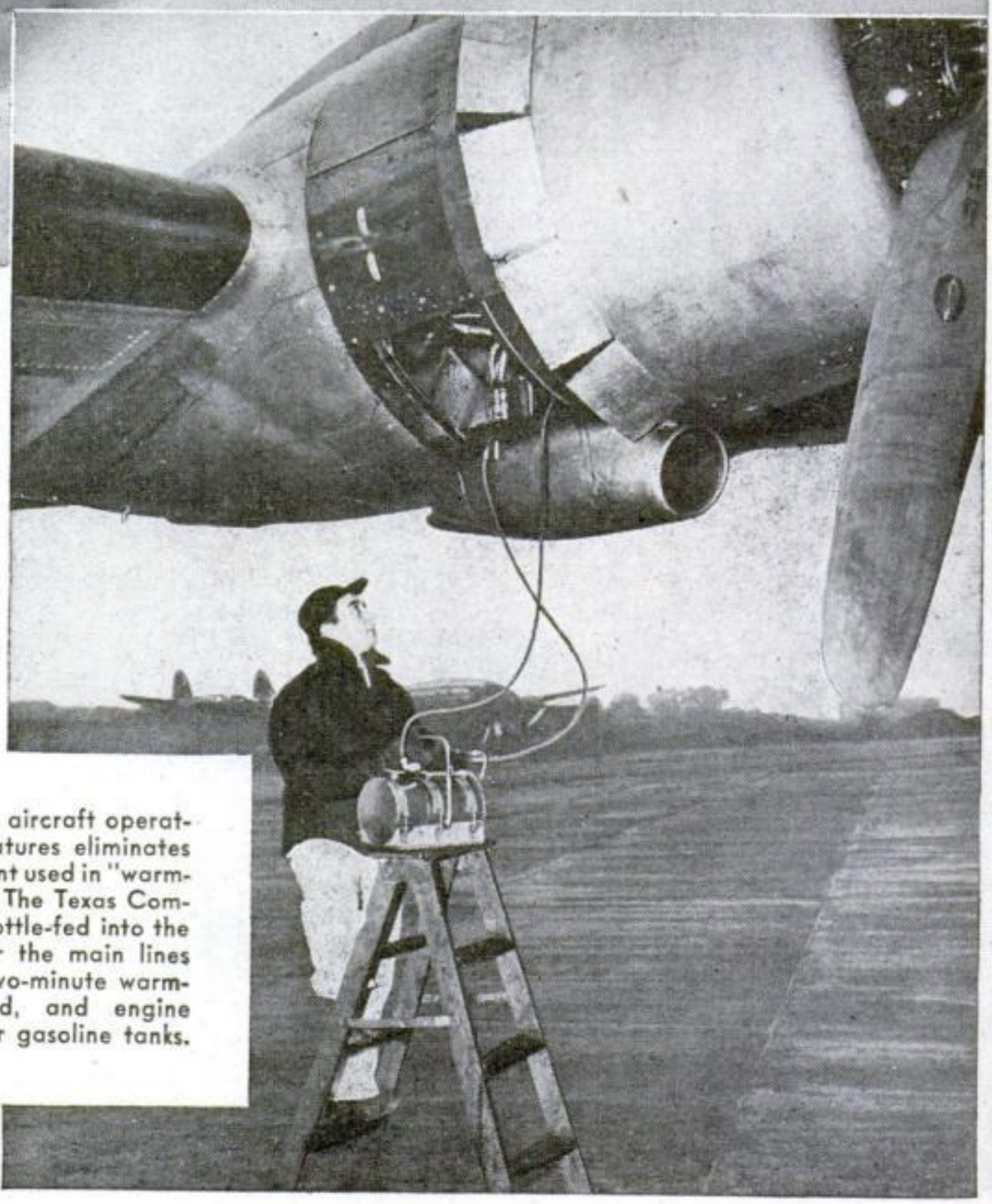
**Baby buggy bodies take shape from a loose pad of sisal impregnated with plastic. Heat and pressure convert the pad into a strong, light, one-piece body.**



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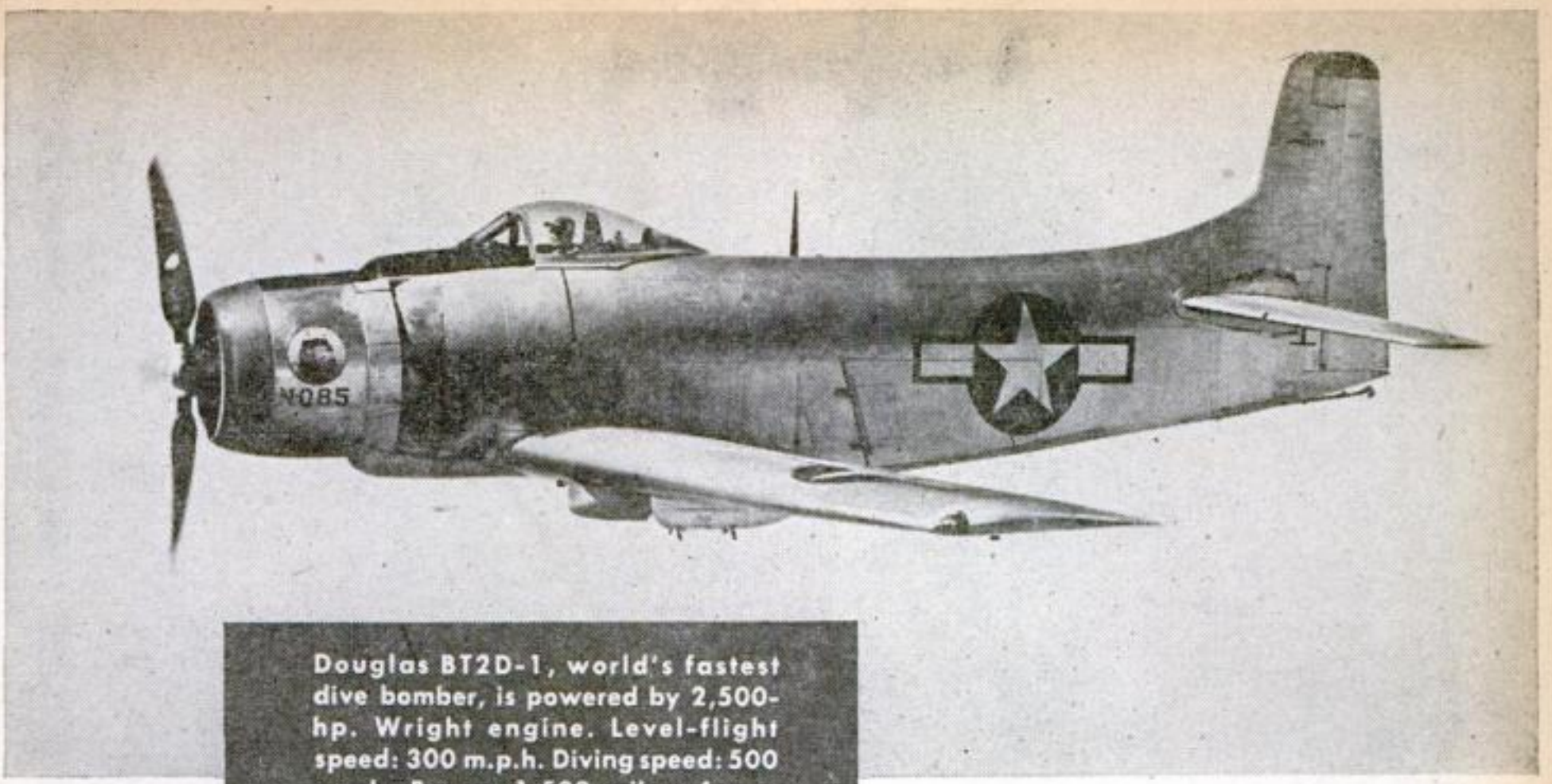
Hurtling skyward at almost a 45-degree angle, a jet-propelled Lockheed P-80 Shooting Star gets added push from two external rocket-assist units that cut the take-off run in half. The rockets develop 2,000 pounds of thrust for 12 to 15 seconds to supplement the 4,000 pounds of thrust generated by the GE I-40 jet turbine.



A cold-starting fuel for aircraft operating in subzero temperatures eliminates all preheating equipment used in "warming up." Developed by The Texas Company, the new fuel is bottle-fed into the regular fuel lines after the main lines are shut off. After a two-minute warm-up bottle is removed, and engine draws fuel from regular gasoline tanks.



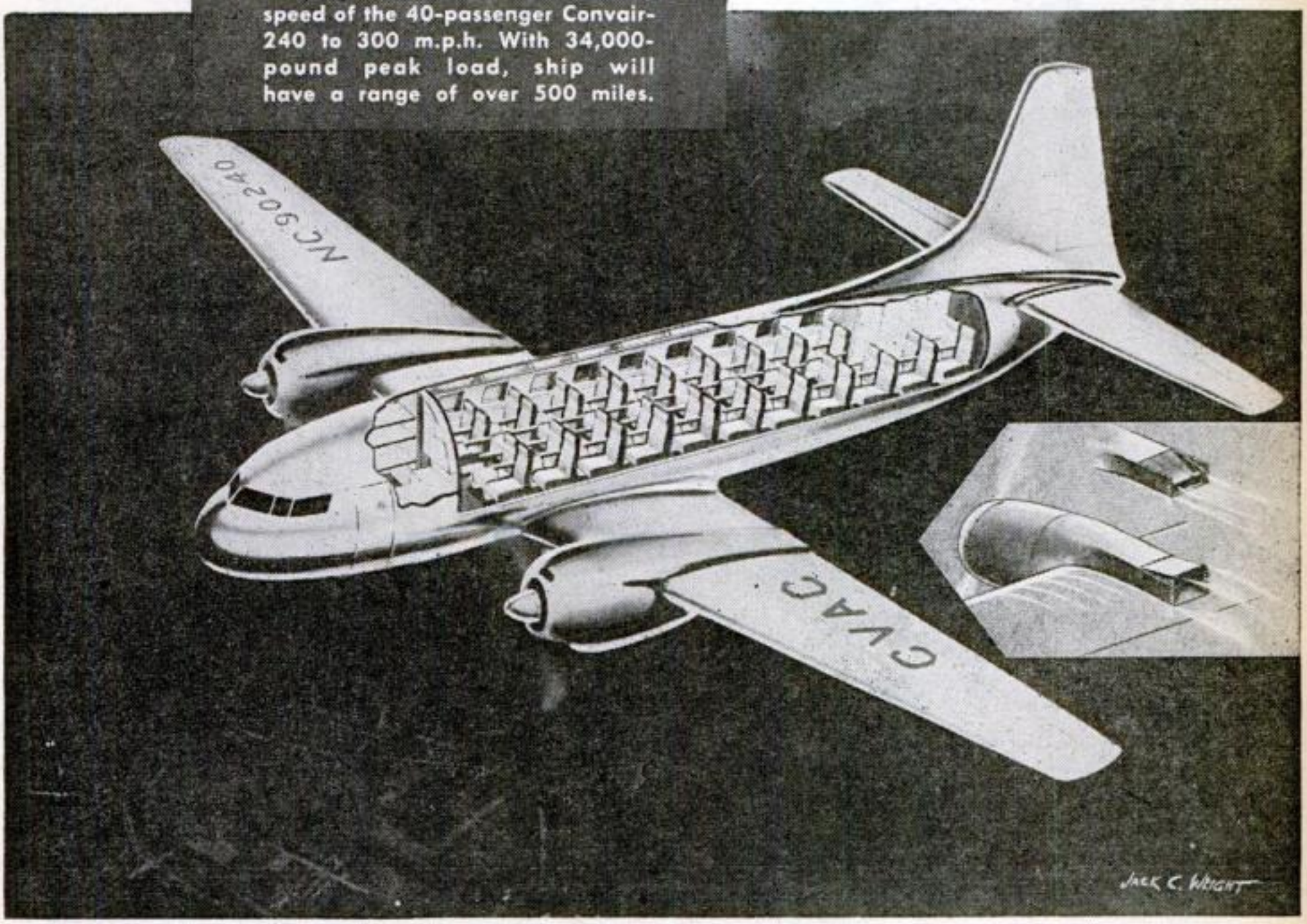
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Douglas BT2D-1, world's fastest dive bomber, is powered by 2,500-hp. Wright engine. Level-flight speed: 300 m.p.h. Diving speed: 500 m.p.h. Range: 1,500 miles. Armament: 6,000 pounds of bombs, rockets, torpedoes; wing machine guns.

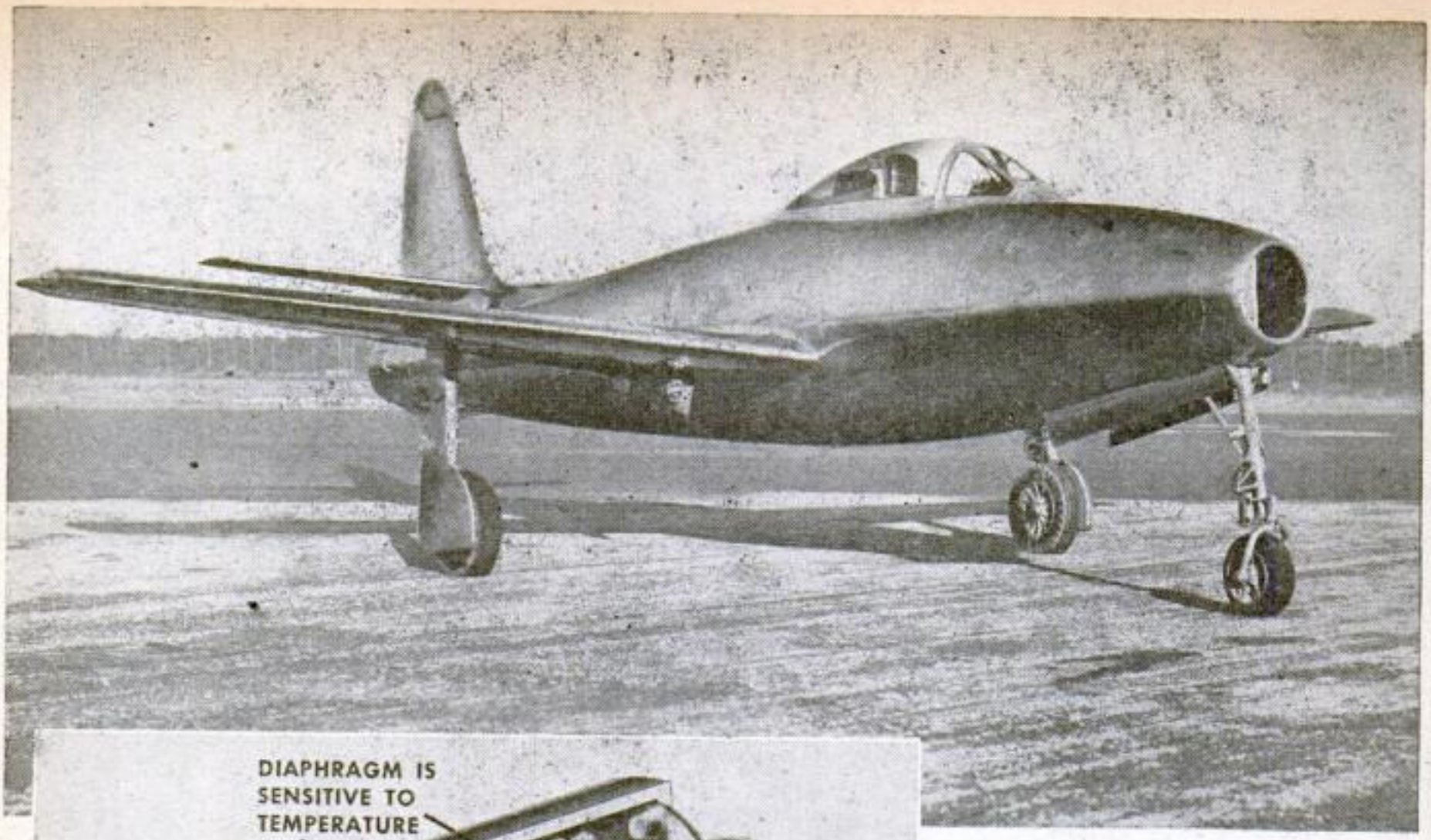
# WHAT'S NEW in AVIATION

Use of exhaust from the two Pratt & Whitney 2,100-hp. engines (see inset)* helps boost the cruising speed of the 40-passenger Convair-240 to 300 m.p.h. With 34,000-pound peak load, ship will have a range of over 500 miles.

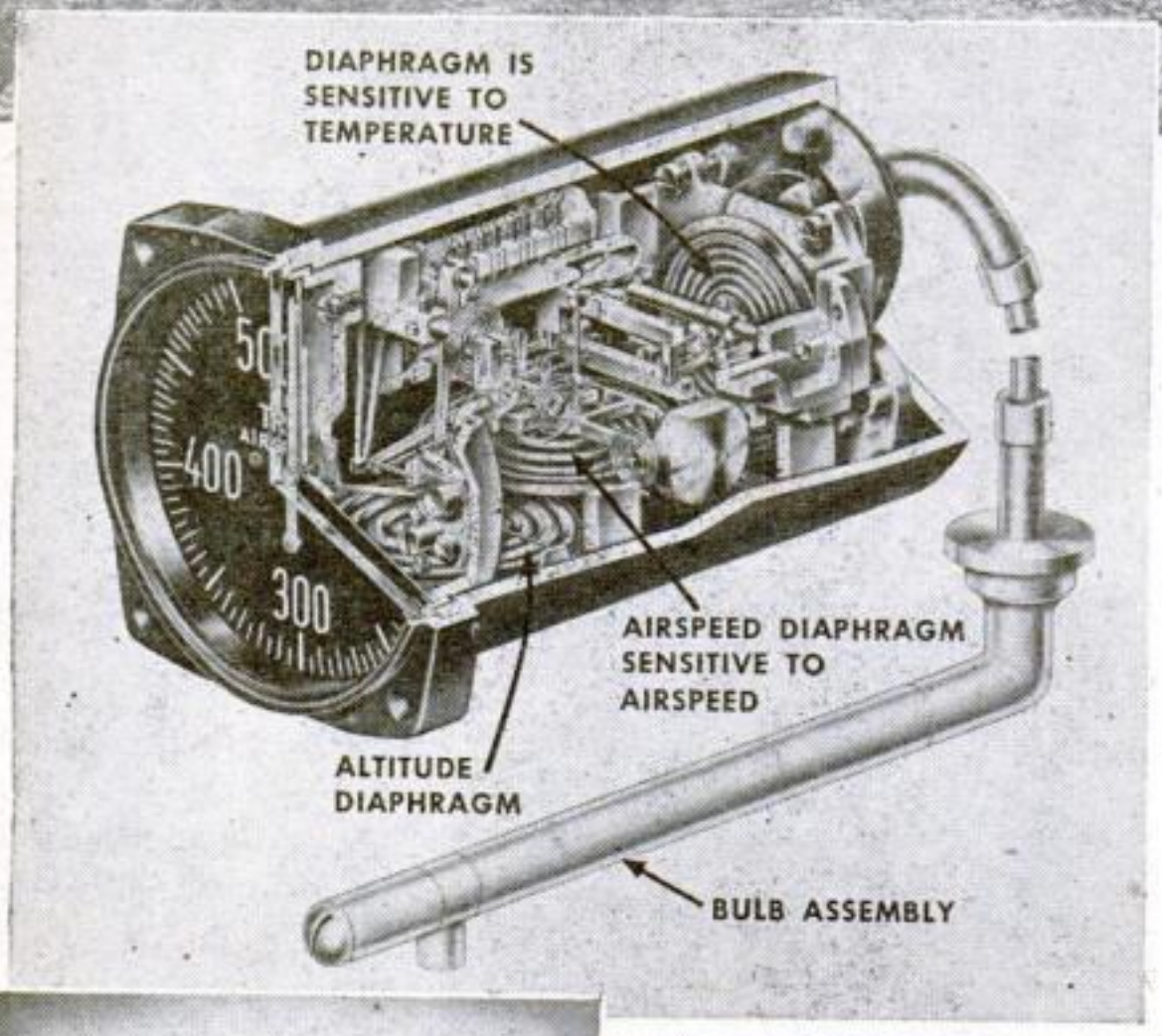





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Republic's XP-84 Thunderjet fighter, successfully test-flown, is powered by a new axial-flow GE jet unit. Note the air scoop in its nose.

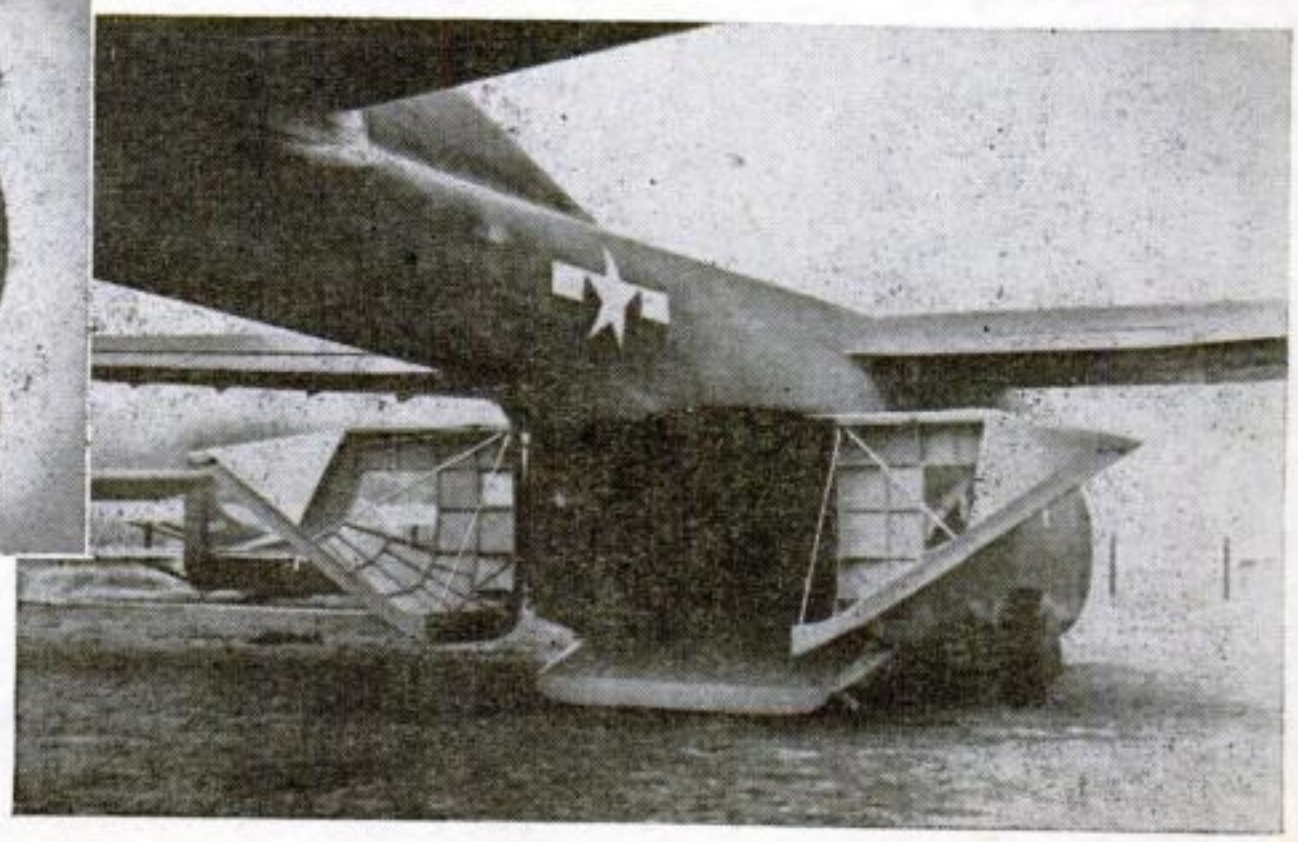



The Kollsman True Airspeed Indicator (left) eliminates involved human computations and shows accurately and instantly the speed at which an airplane is flying.

Bulky air freight (11,500 lbs. of it) can be loaded on fat Laister-Kauffman transport below. Its two Pratt & Whitney engines can be removed in 8 hours, making it a glider.




The Hobbs Flight Hour Meter automatically logs a plane's actual flying time. A switch actuated by air pressure controls the meter.





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## Tiny Circuits of Silver 'Ink' Baked on Ceramic Base Plates

By HARTLEY E. HOWE

TECHNIQUES borrowed from the graphic arts now "print" whole radio circuits. The maze of wiring is replaced by a pattern of silver "ink" on a ceramic base as hard as a gem. Resistors are sprayed on. Condensers are paper-thin disks. Tubes are the size of flashlight bulbs. The result is a circuit that is not only extremely compact, but rugged, simple to check and repair, and easy to manufacture quickly and precisely.




Methods developed to build an entire radio transmitter-receiver into the deadly proximity fuse, here compared in size to a standard radio tube, are used in printing radio circuits for commercial purposes.

Once again one industry has borrowed a process from another, as in the adaptation of paper-making techniques to tin-plate manufacture. In this case, it is the familiar silk-screen process used in printing labels, posters, and textile designs. With it, a master circuit can be reproduced simply and exactly from a pattern almost as easily as a calling card is printed.

Behind the new application of this old process lies a wartime search to perfect one of our most potent secret weapons, the proximity fuse (PSM, Dec. '45, p. 86). This deadly gadget enabled an antiaircraft gun to knock down a hostile plane without a direct hit, by an elaborate electrical hookup that exploded the shell as it neared the target. The fuse, no longer than an ordinary radio tube, carried a completely self-contained turbogenerator, control circuits, safety devices, and an entire radio transmitter-receiver.

The space problem was tough enough, but a worse one was the terrific impact that the fuse had to sustain at the moment of firing

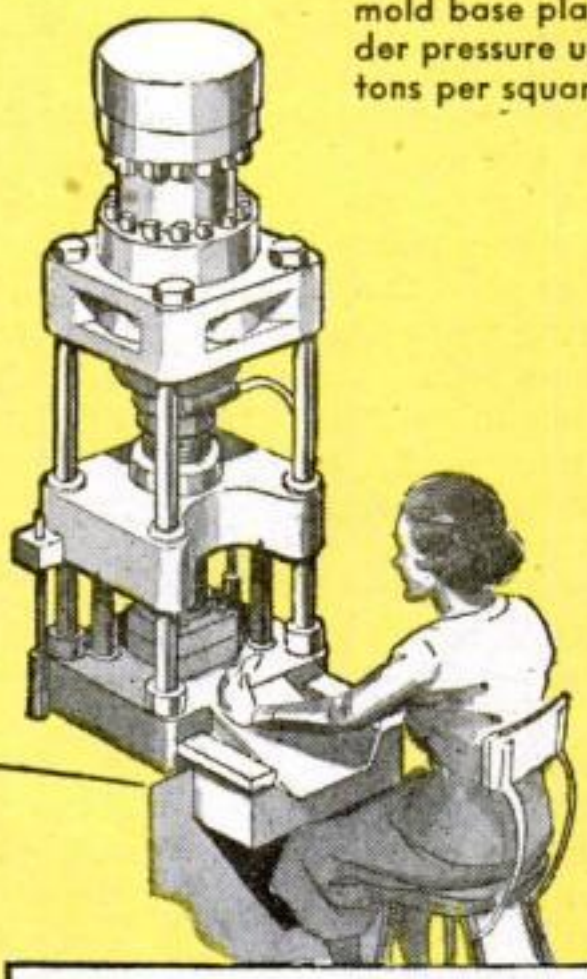


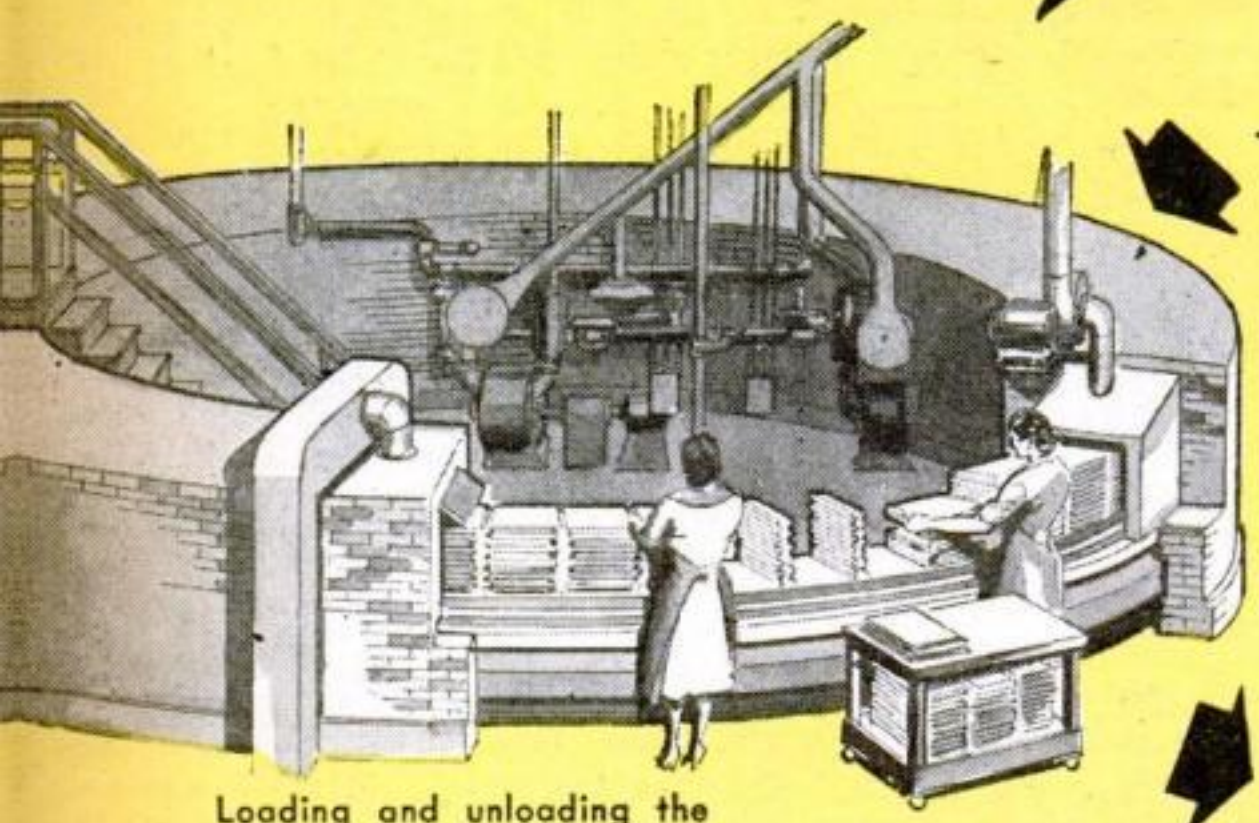
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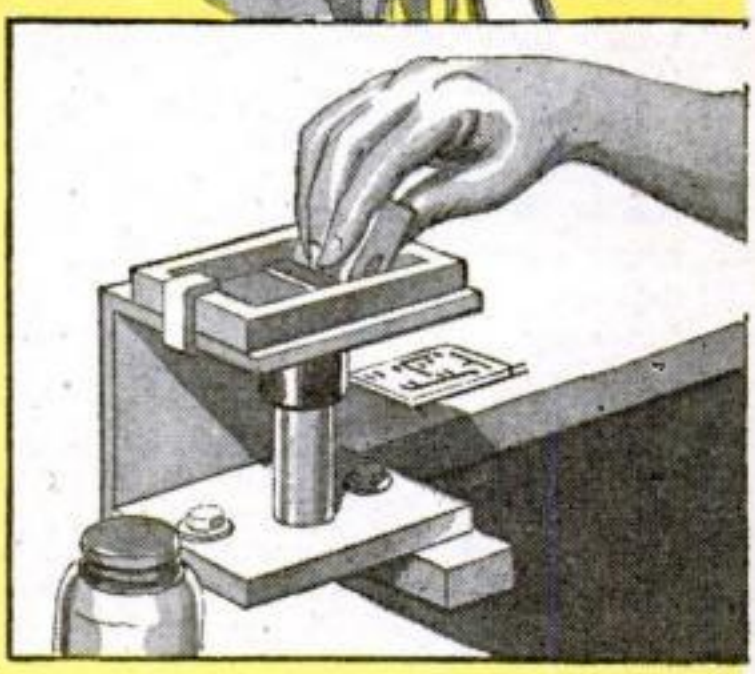
Inside this rotary mixer, talcs, clays, and water are whirled into a smooth mass, from which base plates of calling-card size are made for tiniest radio sets.

Big double-acting hydraulic presses mold base plates under pressure up to 10 tons per square inch.



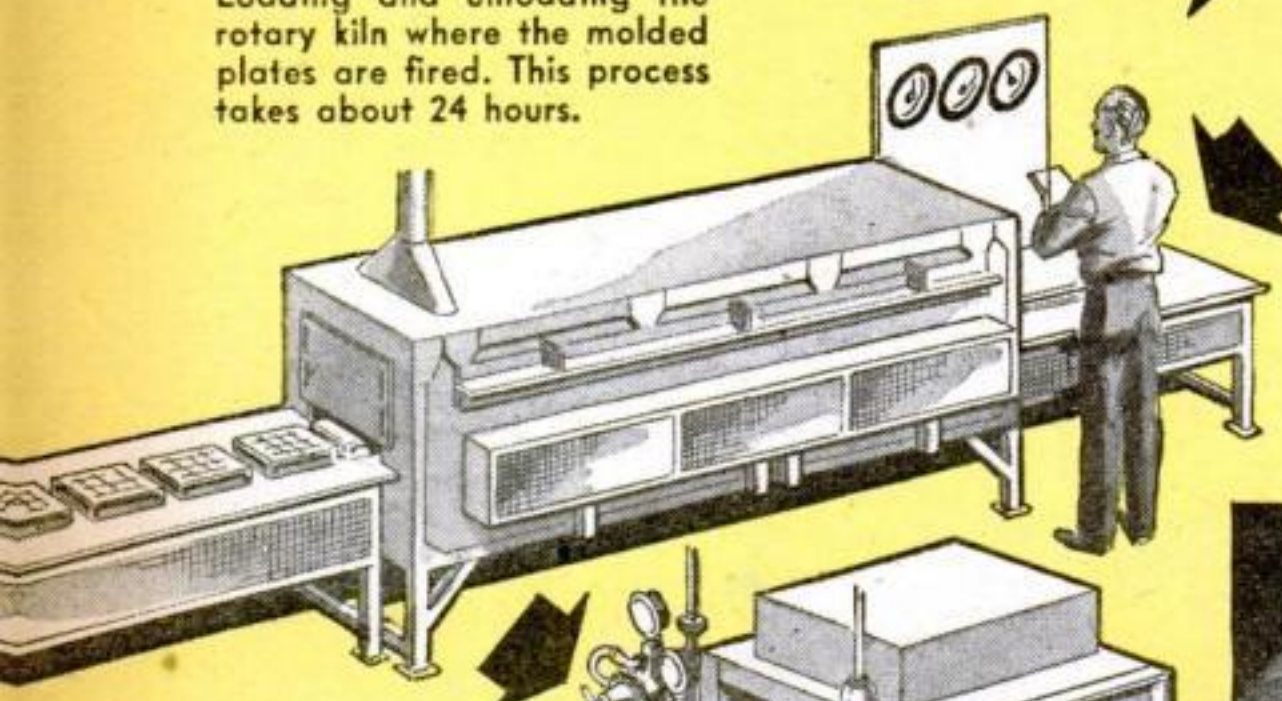


Loading and unloading the rotary kiln where the molded plates are fired. This process takes about 24 hours.

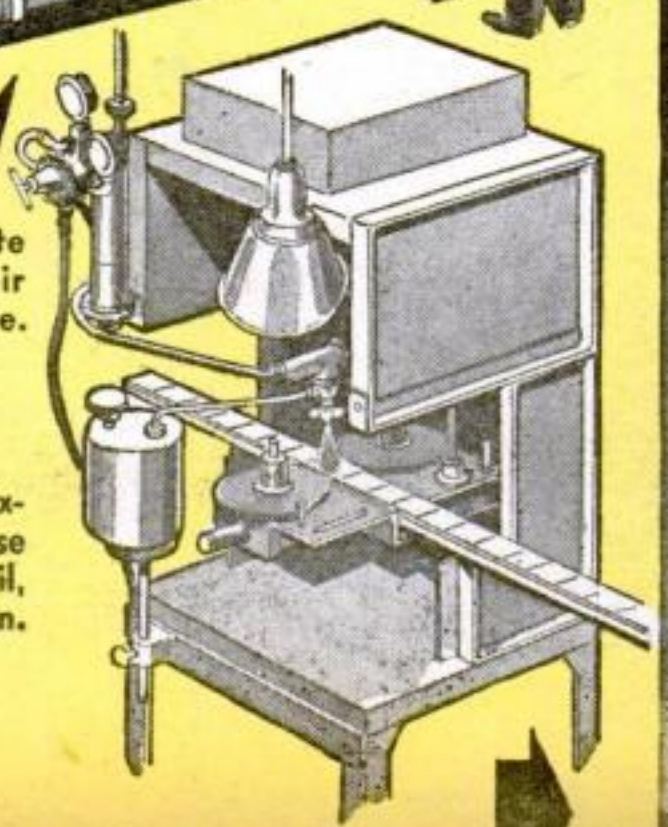


Printing a radio circuit on its base by forcing silver paste through stencilled silk screen with neoprene bar.

A small penlike soldering iron is used to fasten the miniature tube leads to the ceramic base plate.



Circuits of silver paste are baked firmly to their bases in the furnace above.



Resistors of a carbon mixture are sprayed onto base plates through a stencil, then baked into position.



—equal to a blow 10,000 times its own weight. Conventional wired circuits just couldn't take it.

The whole problem was turned over to the National Bureau of Standards, working with the Centralab Division of Globe Union, Inc. Centralab had a lead toward a solution. Before the war its researchers had worked on a way to build capacitors and resistors by bonding silver to ceramics. Now they applied the principle to whole circuits —wiring, capacitors, and resistors all on one ceramic base. It worked; the proximity fuse began smelling out and destroying enemy planes in upper space—and today's printed circuits are available for peacetime uses.

First step in printing a circuit is to make a pattern, which is photographed and printed on a silk screen coated with sensitive emulsion. The portions masked by the pattern are water-soluble and can be washed away, leaving the exposed emulsion on the silk in a stencil pattern of the circuit.

The "ink" is finely divided metallic silver or silver oxide mixed with binders and solvents to form a paste. This is spread on the screen, which is placed on the ceramic base plate. A neoprene bar is then pulled along the screen, forcing the silver through the stencil onto the surface of the plate to print the circuit. The silk mesh makes the deposit uniform throughout. It is fixed in place by baking it at a temperature between 1,300 and 1,500 degrees. The heat removes the solvents and binders and leaves the pure silver bonded to the plate with a tensile strength of about 3,000 pounds to the square inch.

The circuit completed, the next step is to add the resistors. These are also "ink," but a different compound: a conducting material such as finely divided carbon, an inert filler, a binder and a solvent. By combining proper proportions of these elements, and making variations in the dimensions of the resistor, exact resistances can be made ranging from 3 ohms to 200 megohms.

The carbon mixture is sprayed on the base plate through a stencil, and after air drying the plates are again baked, this time at the much lower temperature of 300 degrees. After being coated with resin the resistors are highly stable under heavy loads or high humidity.

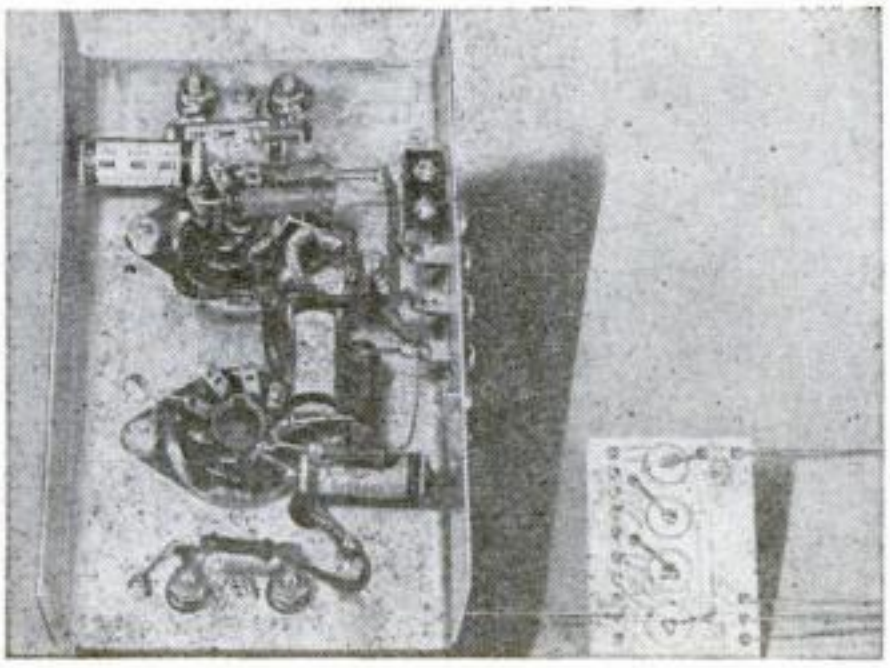
The capacitors or condensers are the third element to be added to the circuit. These are also of a novel type: paper-thin ceramic disks, silvered on both sides and from ⅛ to ⅜ of an inch in diameter. Attaching these tiny capacitors to the base plate is a delicate job. A low-temperature bismuth solder must be used because the heat of normal soldering would crack the thin condenser plates. In addition, two percent silver must be added to the solder to prevent it from absorbing the silver from the base plate.

Since ordinary solder would soak up the circuit, silver solder is also used in the final step, adding the tubes. The new tiny tubes developed during the war, highly efficient, rugged, and with an extremely low filament drain, are used to keep the unit compact.

The plates on which the circuits are printed are made of a ceramic called steatite. When molded, under great pressure, the plates are chalklike. To shrink and harden them, they are dipped in glass-forming materials and fired in kilns at around 2,400 degrees Fahrenheit. When they come out they are hard enough to cut glass. Steatite will not absorb water, solvents or acids even when completely submerged—extremely important for electrical use.

Centralab does not plan to produce complete radio sets itself but rather component parts, including amplifiers, filters, control circuits and small subassemblies, for other manufacturers. Subcircuits printed on plates plugged into the main chassis are as easy to change as a tube. This is particularly important in the export trade: radio repairmen are few in remote areas and a plugged-in circuit that can be bought as a unit, like any spare part, will enable the owner to make his own repairs.

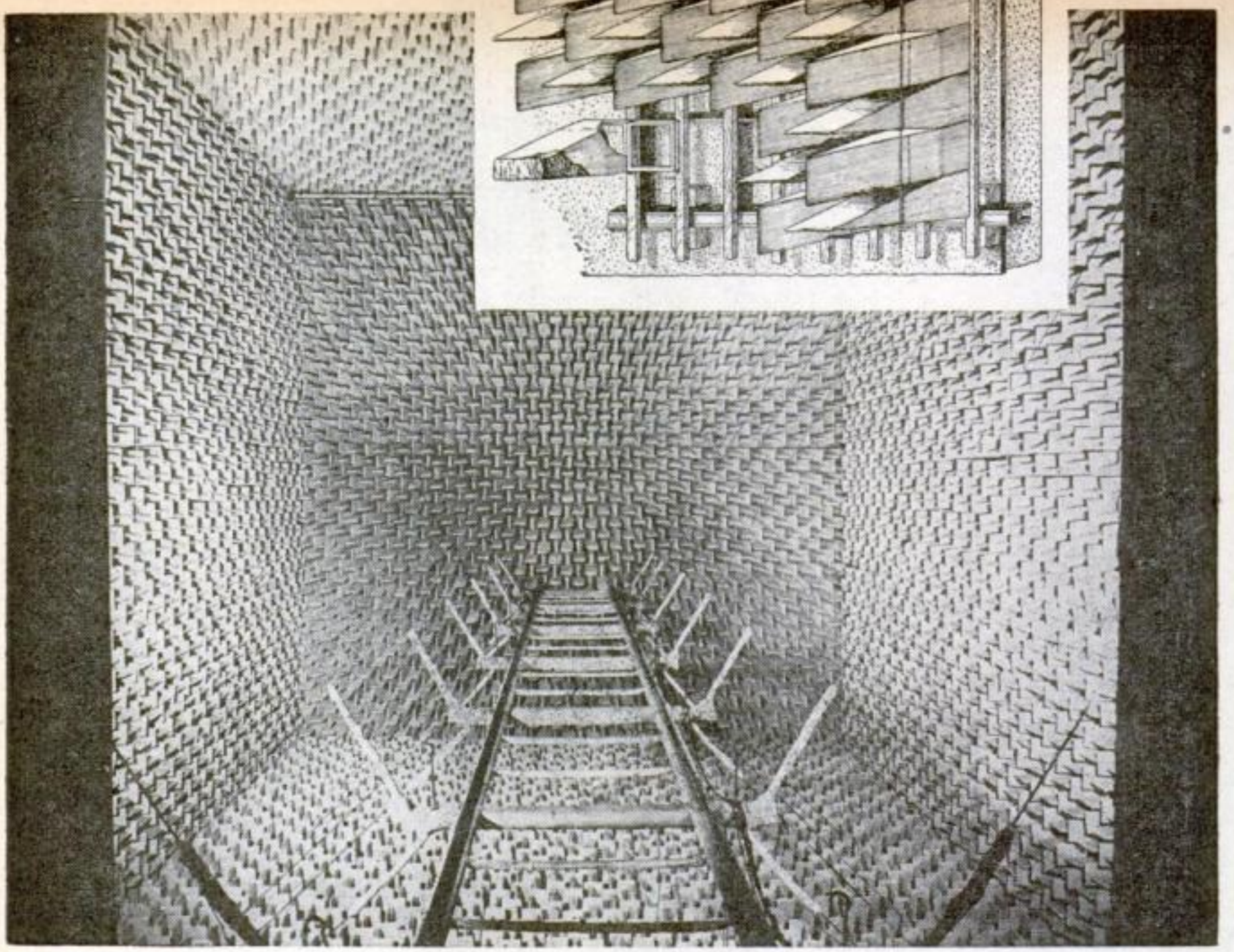
Vest-pocket radio telephones to be carried by individuals still lie in the future but there are many immediate uses for the tiny circuits. Hearing aids can be made far smaller and more compact. Meteorological instruments can be lighter and stronger. Electronic controls of all sorts, in fact, will benefit from the ruggedness and simplicity of the silver circuits, and from the small amount of space they occupy.



The bottom of a regular radio chassis, with its clutter of wires and parts, contrasts strikingly with the compact base plate of a printed radio circuit, shown at a comparable stage of assembly.



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# Echoless Room Lined With 20,000 Wedges

AT PEARL Harbor, lack of good intercommunication equipment and insulation, plus mechanical noises and acoustical tricks of altitude, plagued the Air Forces. Harvard's Electro-Acoustic Laboratory discovered the reasons; then designed and tested new equipment for use in the planes that one general called as helpful as radar.

Constructed for research was an echoless room simulating atmospheric conditions at high altitudes; less than 1/1000 of the sound that strikes a wall is reflected. Peacetime acoustics will be improved too by the use of this chamber. Microphones have been calibrated in it for sound measurement.

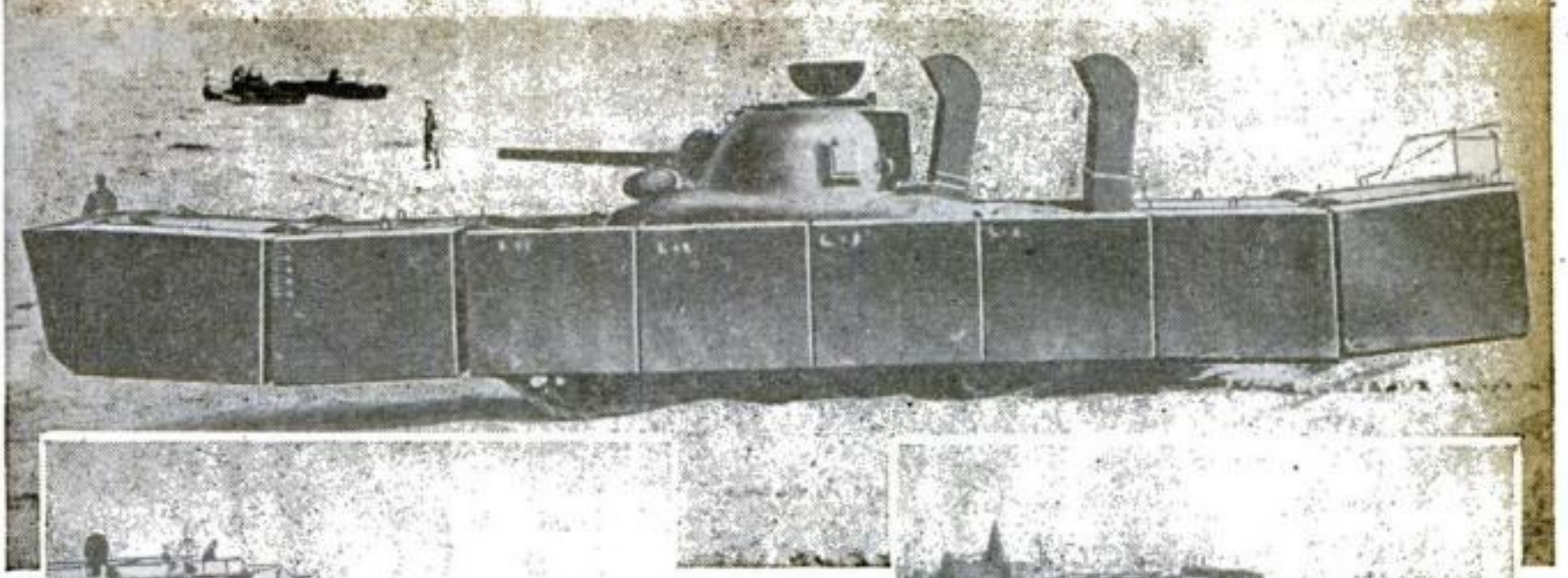
Foot-thick concrete walls, ceiling, and floor are lined with 20,000 Fiberglas wedges covered with muslin bags. Wedges are held 10 inches from the walls by a wooden framework, behind which there is an assembly of fiberboard cells to prevent sound waves from circulating parallel to the walls. Each wedge is set at right angles to its neighbor, and to guard against sagging, it is braced by heavy wire. Track suspended above the floor provides access to cars carrying equipment.

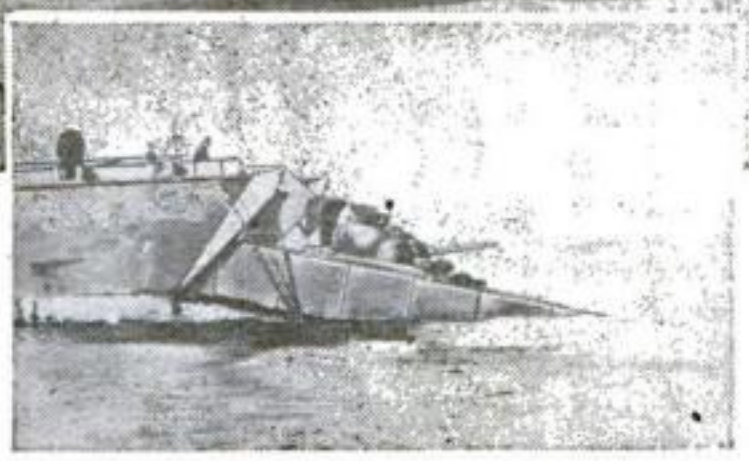
# Electronic Cardiograph Records As It Functions

IMMEDIATE readings of heart action are now possible through the use of the Cardiotron, first direct-writing electrocardiograph. The 34-pound portable instrument is shown here in use. A stylus that works by electrical impulses traces cardiac action on a specially processed paper feeding out of the machine at controlled speeds. With ordinary care, the records are permanent.



# Tank "Battleships" Escorted Invasion Troops in Pacific

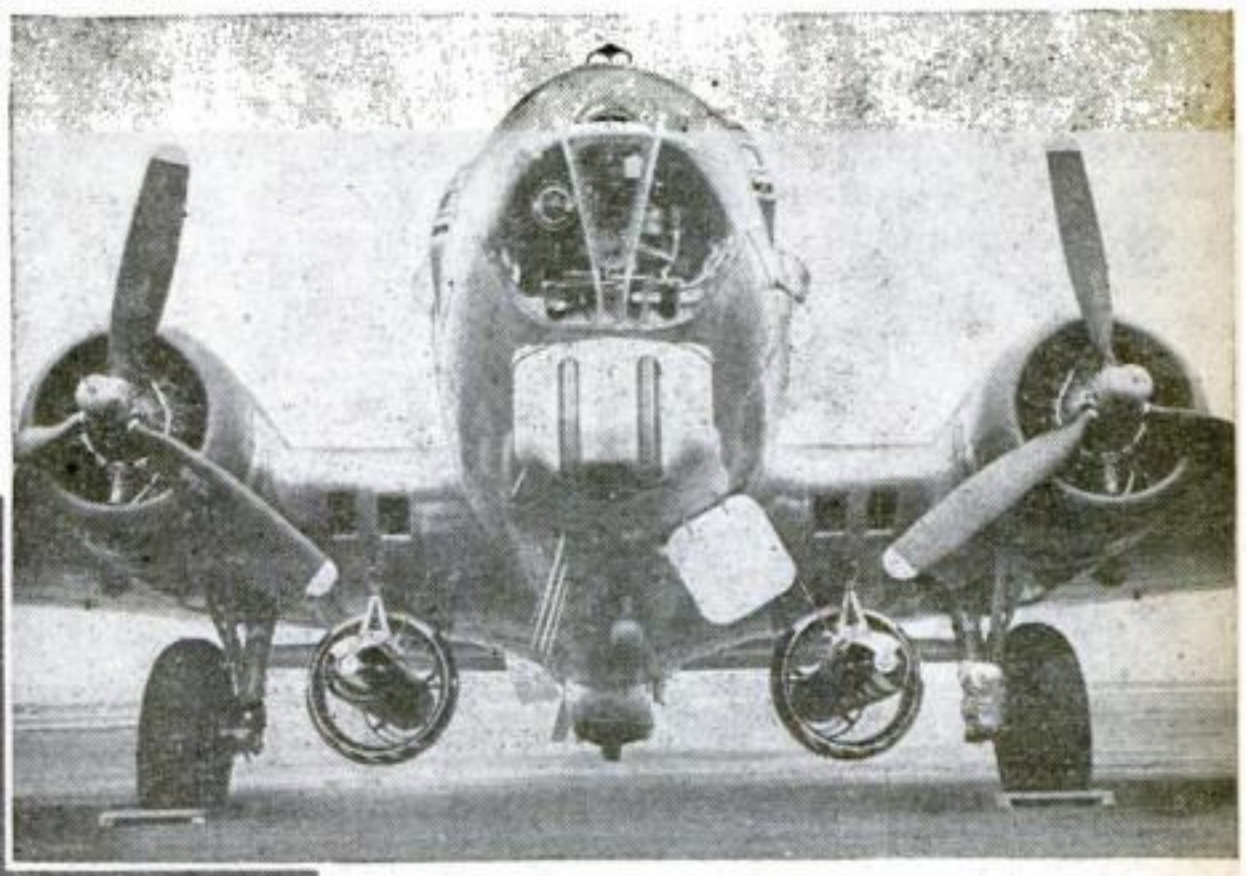




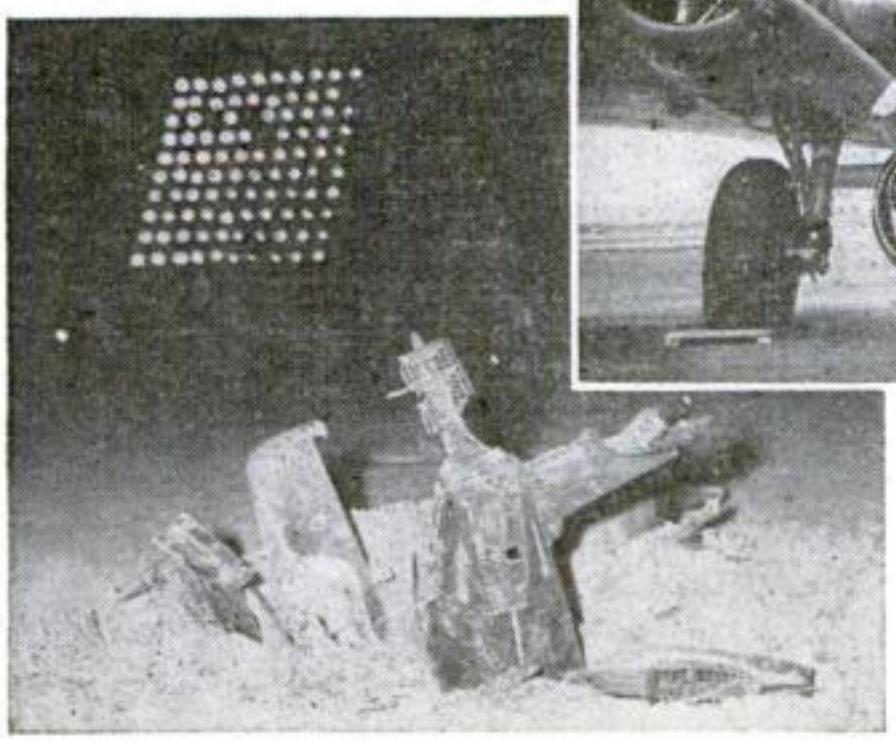


Supported by rigidly attached steel pontons each filled with rubber sponge, 30-ton Army tanks became tiny battleships that swam ashore from landing craft firing their turret guns to support beachhead invasion troops in the Pacific. First used at Okinawa and manned by U. S. Marines, the unorthodox warships are now disclosed to have waddled through heavy seas at 5½ miles an hour. The tracks propelled them. On hitting the beaches, the girdles of pontons were blasted loose by explosive rivets controlled by the tank crews, enabling the tanks to pitch into the battle on land. Motor exhaust gases were carried off by the ventilators that stick up like periscopes. The Carrier Corp., Syracuse, N. Y., peacetime makers of air-conditioning units, sped production of 500 "swimming" tanks.

# Missiles *that find the LIGHT*



Shown here are two forms of the uncanny "Roc," the flying radio bomb with the television "eye" (PSM, Feb. '46, pp. 84 and 120). Photoelectric target seekers in the bomb's nose detect a light and direct the killer to it.



How two of the shroud-winged "Rocs" nestle under the wing of a Flying Fortress is shown above. Television shows bombardier where each 1,000-pounder is going and he steers it by radio. First "Rocs" perfected had four wings, carried 500 pounds of explosives. In a test, one of them landed (left) within 25 feet of magnesium-flares target.



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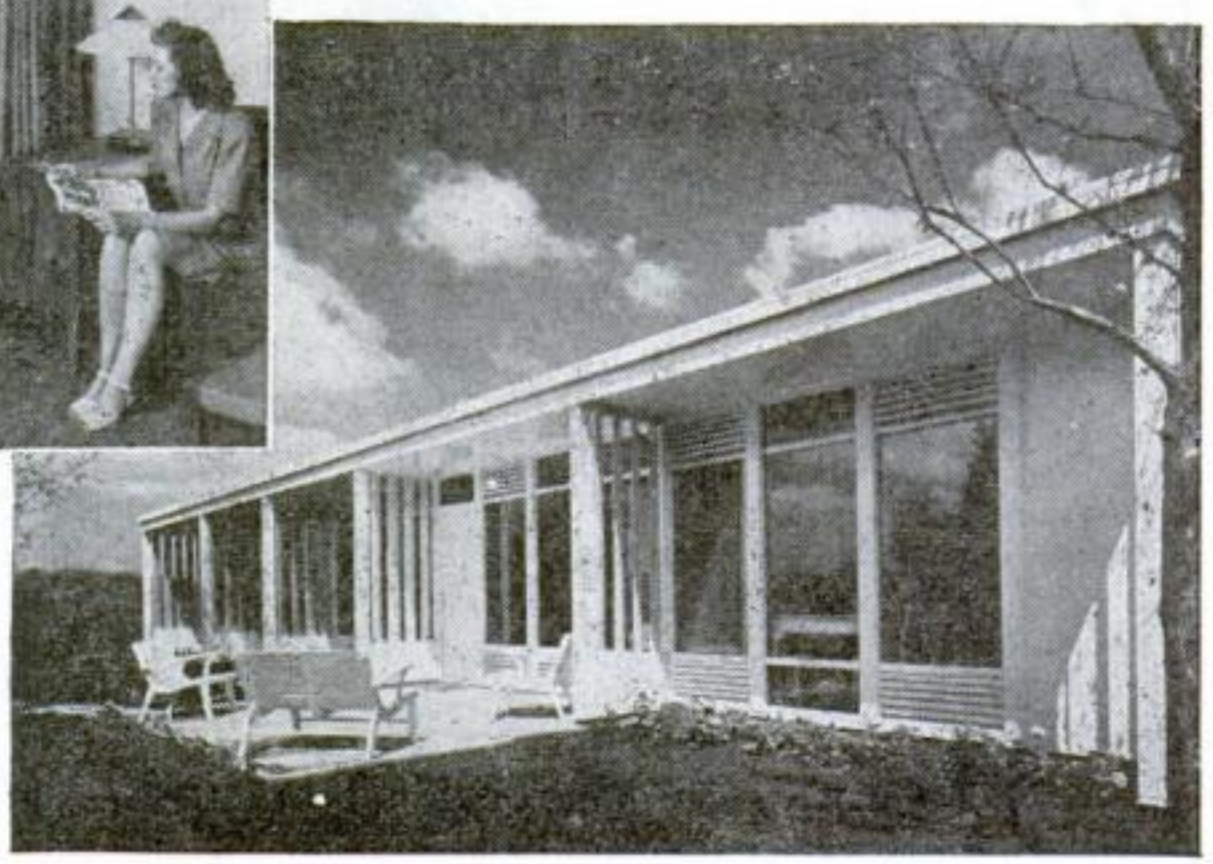
# HOME OWNERS



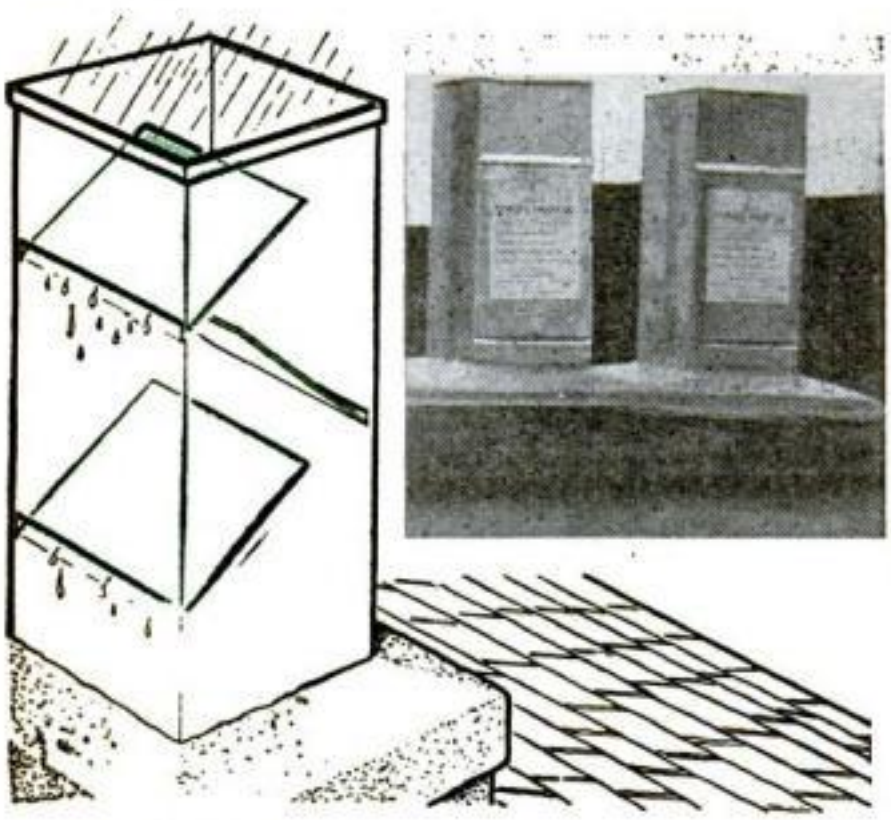
Long, fixed windows with panel openings for fresh air above and below provide plenty of sunlight in the prefabricated solar home.

They are on the south side under wide eaves that admit sun only in winter. Insulated double panes make storm windows unnecessary.

**PREFABRICATED SOLAR HOUSES** combine two currently popular ideas in home design. The one shown here is manufactured in standard wall, partition, and roof-panel units by Green's Ready-Built Homes, of Rockford, Ill. Units can be adapted to a variety of one-story floor plans. No basement is used, the homes being put up instead on poured concrete foundations. They have tile-duct floors for thermostatically controlled warm-air radiant heat from a gas furnace in the utility room.



**BAFFLES IN A NEW CHIMNEY CAP** deflect both rain and cold-air downdrafts. Each of the three baffles in the cap shown below leads to a louver, thus providing outlets for water and wind before they can reach the chimney proper and cause dampness or irregularity of draft. The caps are made by Alois Steiner, of Hoboken, N. J. They are available in three sizes ranging from 6½" to 8½" square and will fit most standard chimneys.



**PROTECTING LINOLEUM** is easy with a new liquid said to make periodic waxing unnecessary. It is applied with a medium-wide brush and dries in an hour. According to the manufacturer, the Wesson Houseware Products Company, of Chicago, the finish acts as a preservative on the linoleum and will withstand many washings.

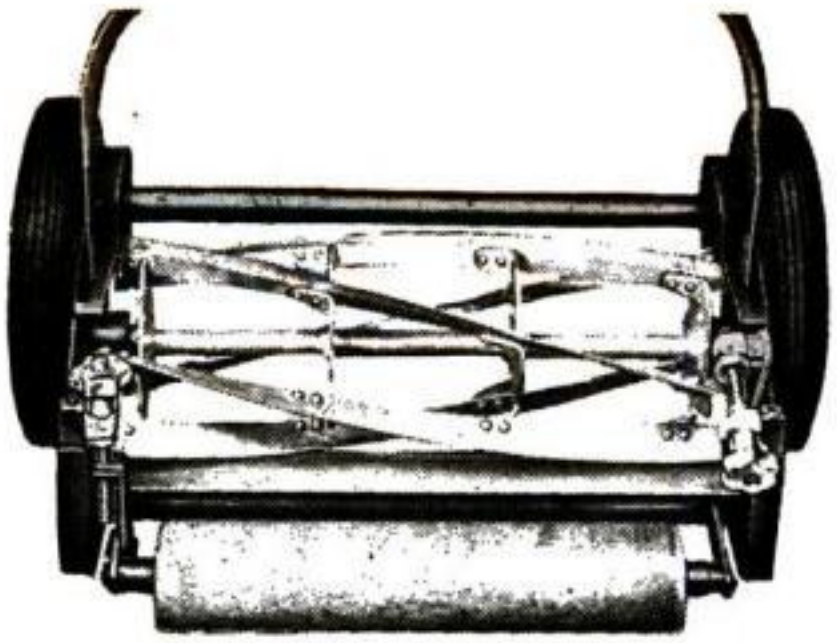



**PIPE JOINTS ARE SEALED** without messiness by use of a new joint compound in stick form. Three or four strokes of the stick across the threads are sufficient. The substance spreads when the connection is threaded on and, besides sealing, acts as a lubricant and rust retardant. It can be used also on nuts, gaskets, and the like. The Lake Chemical Co., of Chicago, is the maker.

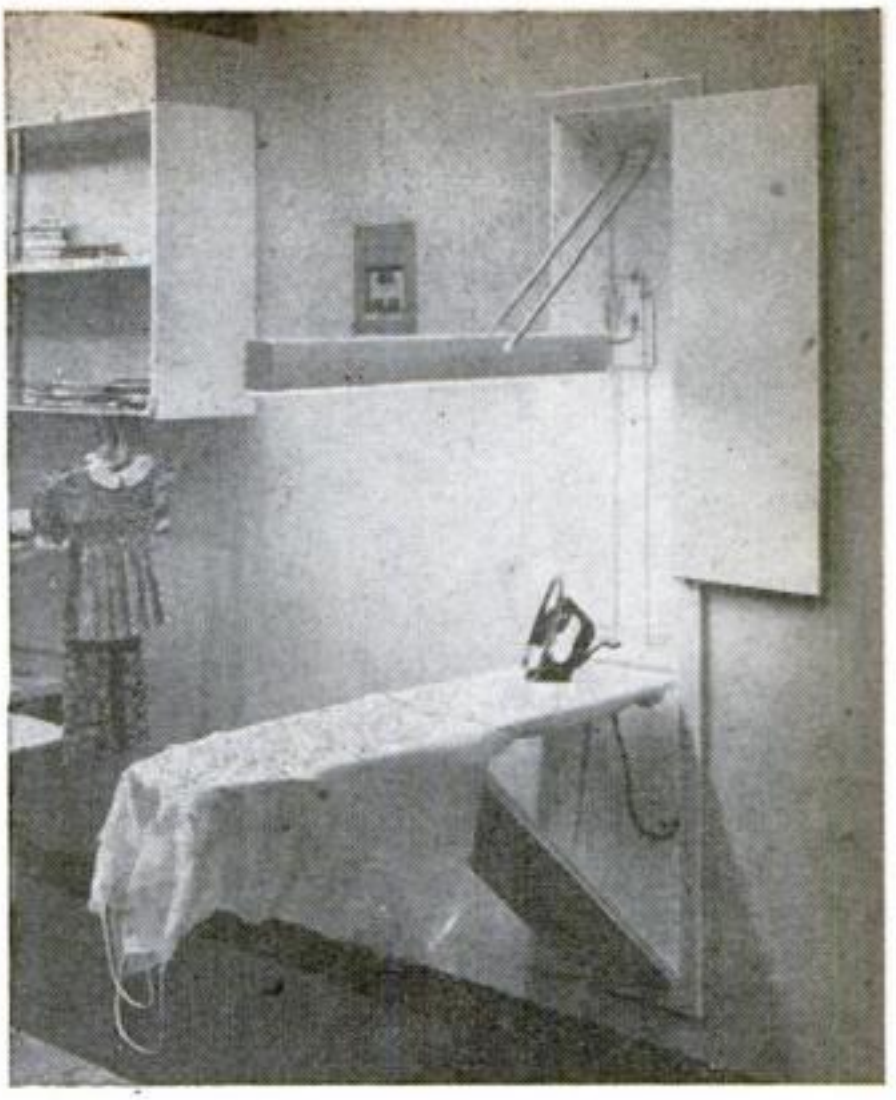




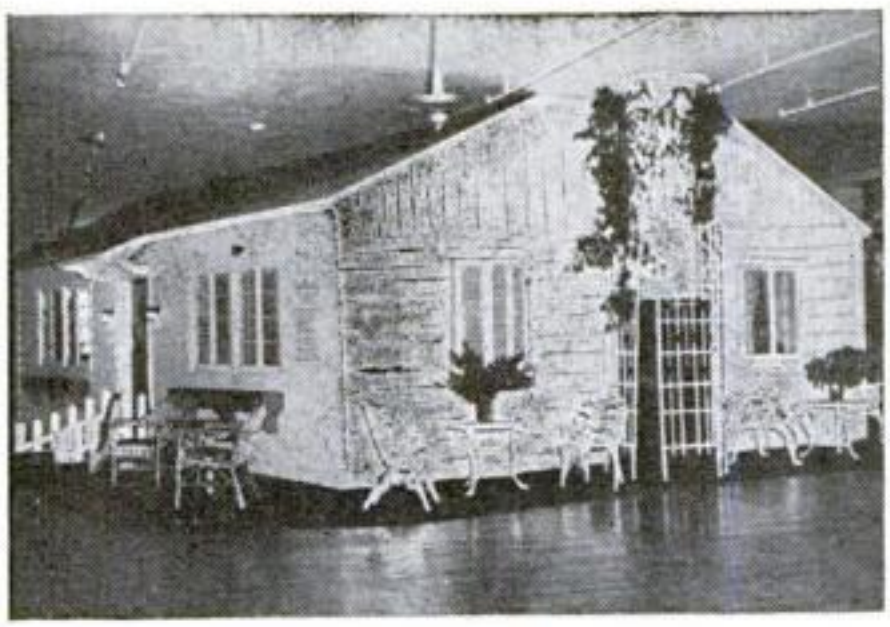
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**QUICK-ADJUSTMENT KNOBS** requiring no wrench or screwdriver are provided on the 17" lawn mower shown above. The two knobs are at the ends of the blades. One connecting with a leveling device adjusts the height of cut, and the other provides adjustments as fine as .001" for clearance between the blades and bottom knife. The mower, known as the Michigan Noiseless, is a product of the new lawn-mower division of Reo Motors, Inc., of Detroit.

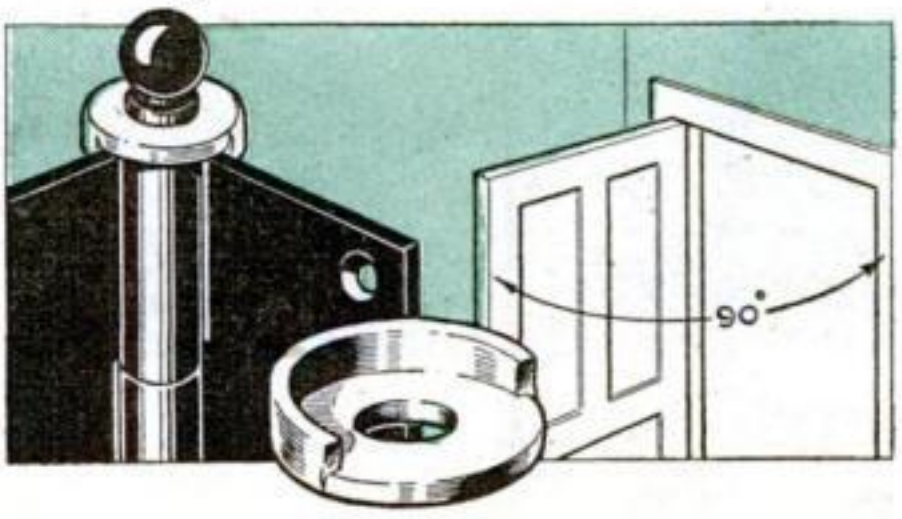


**LIGHT FOR IRONING.** This pivoted fluorescent unit swings out from the same wall cabinet that houses the ironing board, and gives well-located, shadowfree illumination. It was developed by Myrtle Fahsbender, director of home lighting for Westinghouse, and is installed in the John Wanamaker "Home of Vision" exhibited this spring in New York and Philadelphia.



**PREASSEMBLED HOUSES** are now being shown in department stores and sold like furniture. Parts of the prefabricated house shown at left are assembled first with precision jigs in the Johnson Quality Homes plant to assure accuracy. It is on display in the Wanamaker stores.

**BANGING OF DOORS** against walls or doorstops doesn't occur with this washer that limits the opening to 90 deg. It is installed on the pin of the top hinge. Motion is restricted when the hinge leaves come in contact with the raised portion of the washer. The device is made by Door Stop-Nut, Inc., of Chicago.



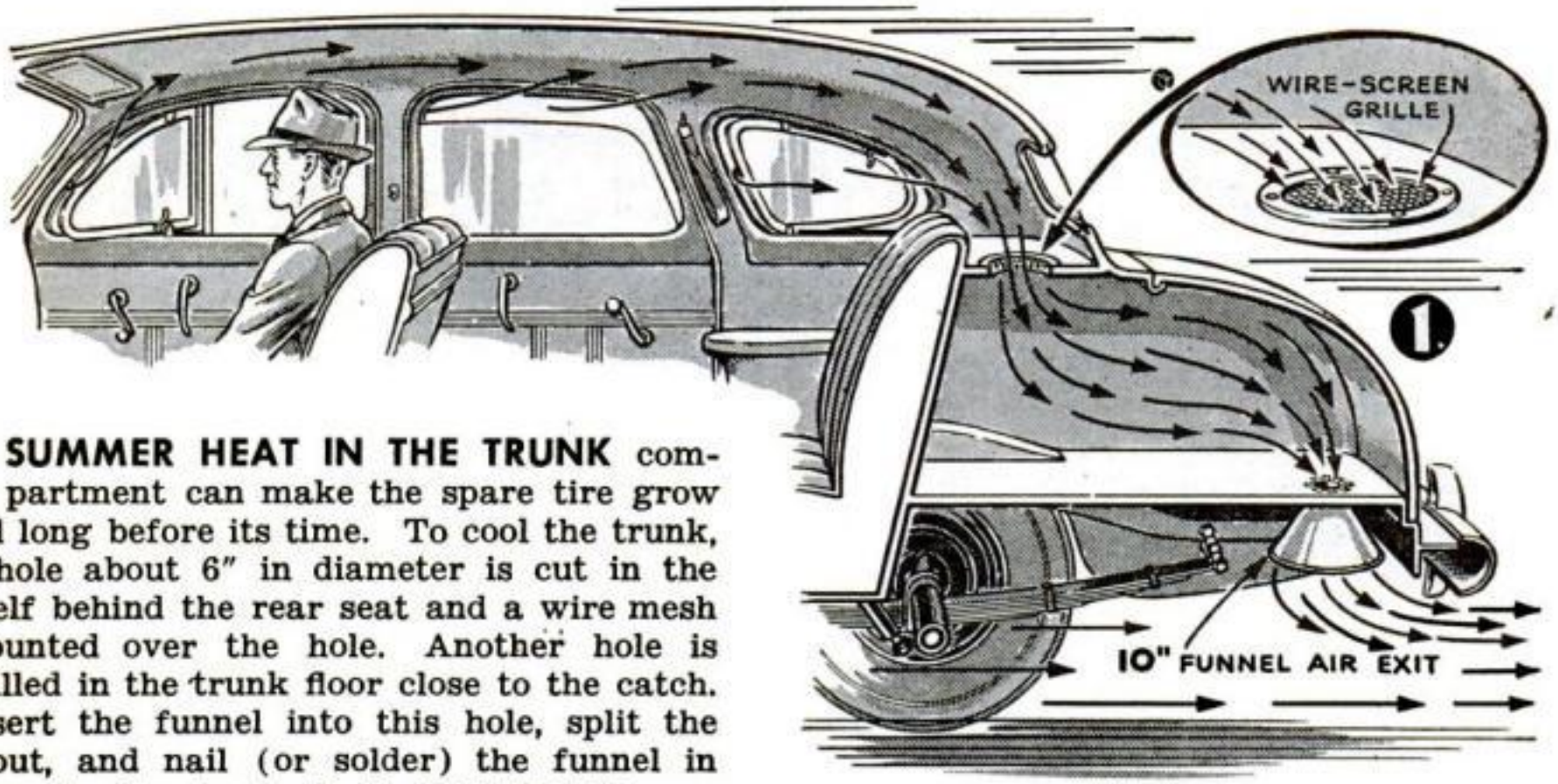

**VENETIAN-BLIND WINDOW PANES** permit home ventilation without draft. The panes look like and operate like Venetian blinds, but they are made of window glass, clear for ordinary use or frosted for privacy in bathroom or bedroom windows. Sizes are standard for installation in windows or doors of new or old homes. Lyle Bishop is the inventor of this Bishop Venta-Glass window, and the Nu-Air-Wa Company, of Los Angeles, distributes it. When closed it is watertight.





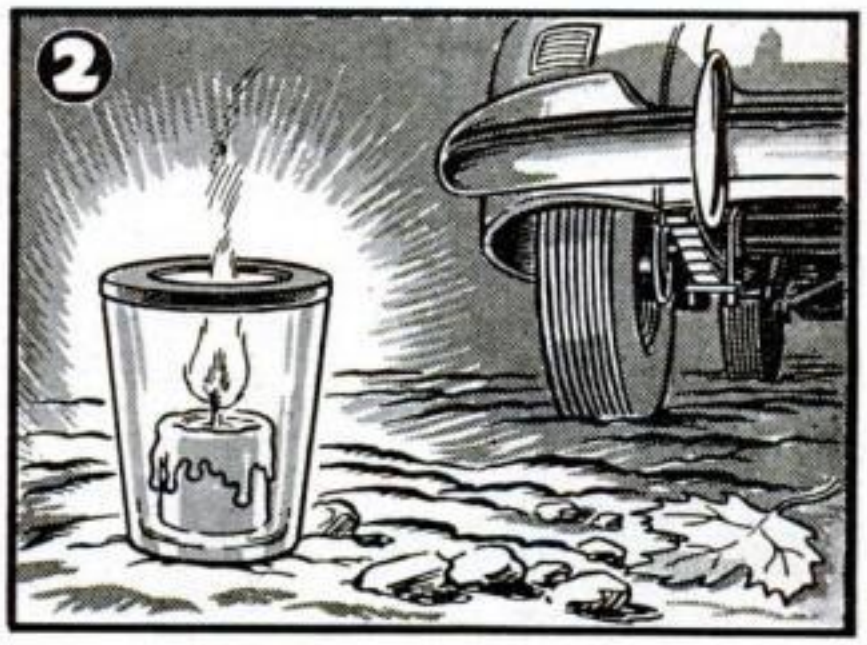
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# USEFUL AUTO HINTS




**1 SUMMER HEAT IN THE TRUNK** compartment can make the spare tire grow old long before its time. To cool the trunk, a hole about 6" in diameter is cut in the shelf behind the rear seat and a wire mesh mounted over the hole. Another hole is drilled in the trunk floor close to the catch. Insert the funnel into this hole, split the spout, and nail (or solder) the funnel in place to the floor.—S. S. PALESTRANT.

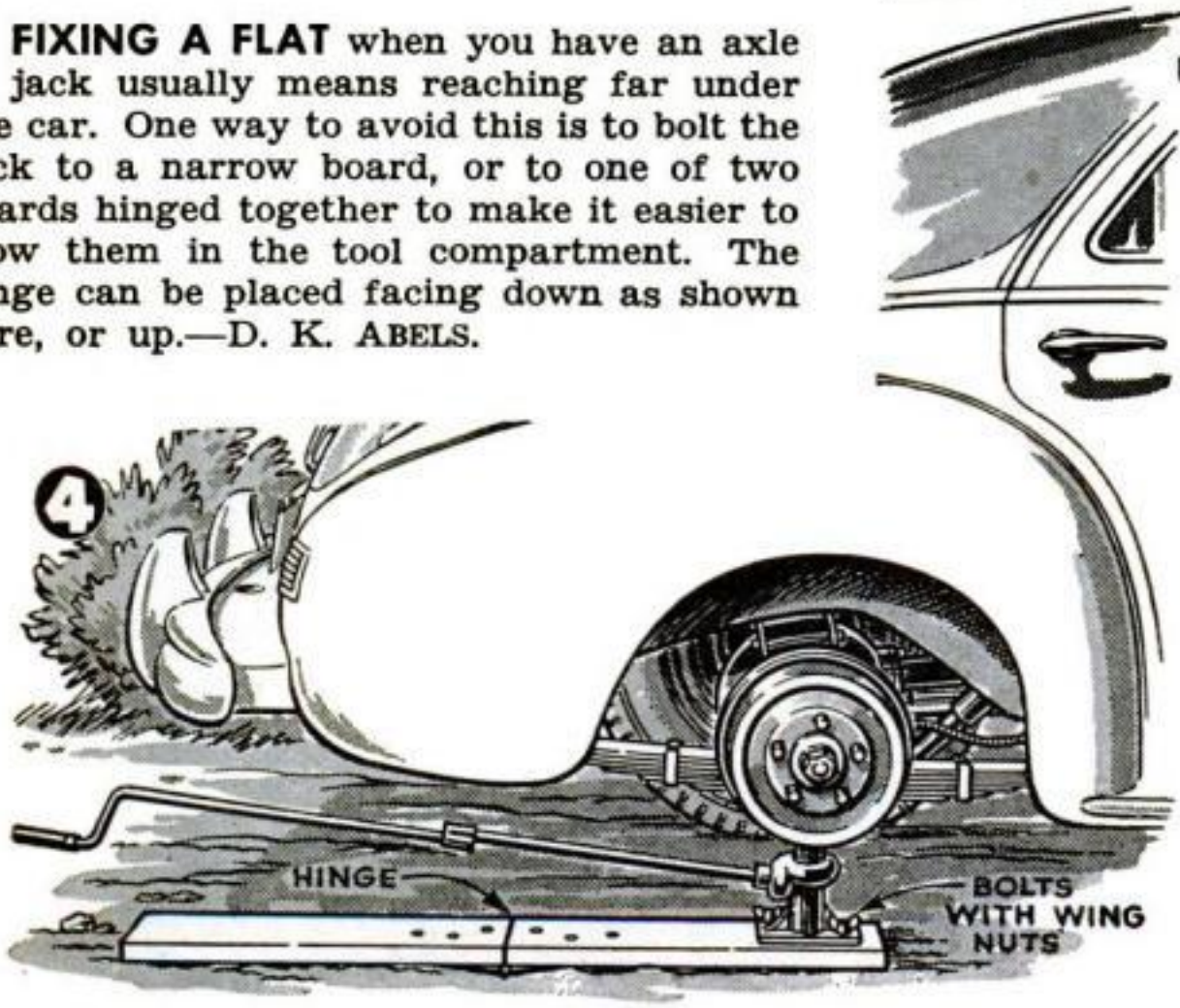
**2 ROADSIDE FLARES** are worth carrying even though you may rarely need them. A simple flare can be made from a jelly jar and a stubby candle. Cut a hole in the jar top and put in a candle.—KEN MURRAY.




**3 CLEANING SPARK PLUGS** is as easy as shaking a stick with the gadget shown at the right, and done the same way. The pipe is tapped at one end to fit the plugs, and closed at the other. Put in some darning needles and a little gasoline and shake briskly.—I. J. STRETTEN.

**4 FIXING A FLAT** when you have an axle jack usually means reaching far under the car. One way to avoid this is to bolt the jack to a narrow board, or to one of two boards hinged together to make it easier to stow them in the tool compartment. The hinge can be placed facing down as shown here, or up.—D. K. ABELS.

Drawings by STEWART ROUSE

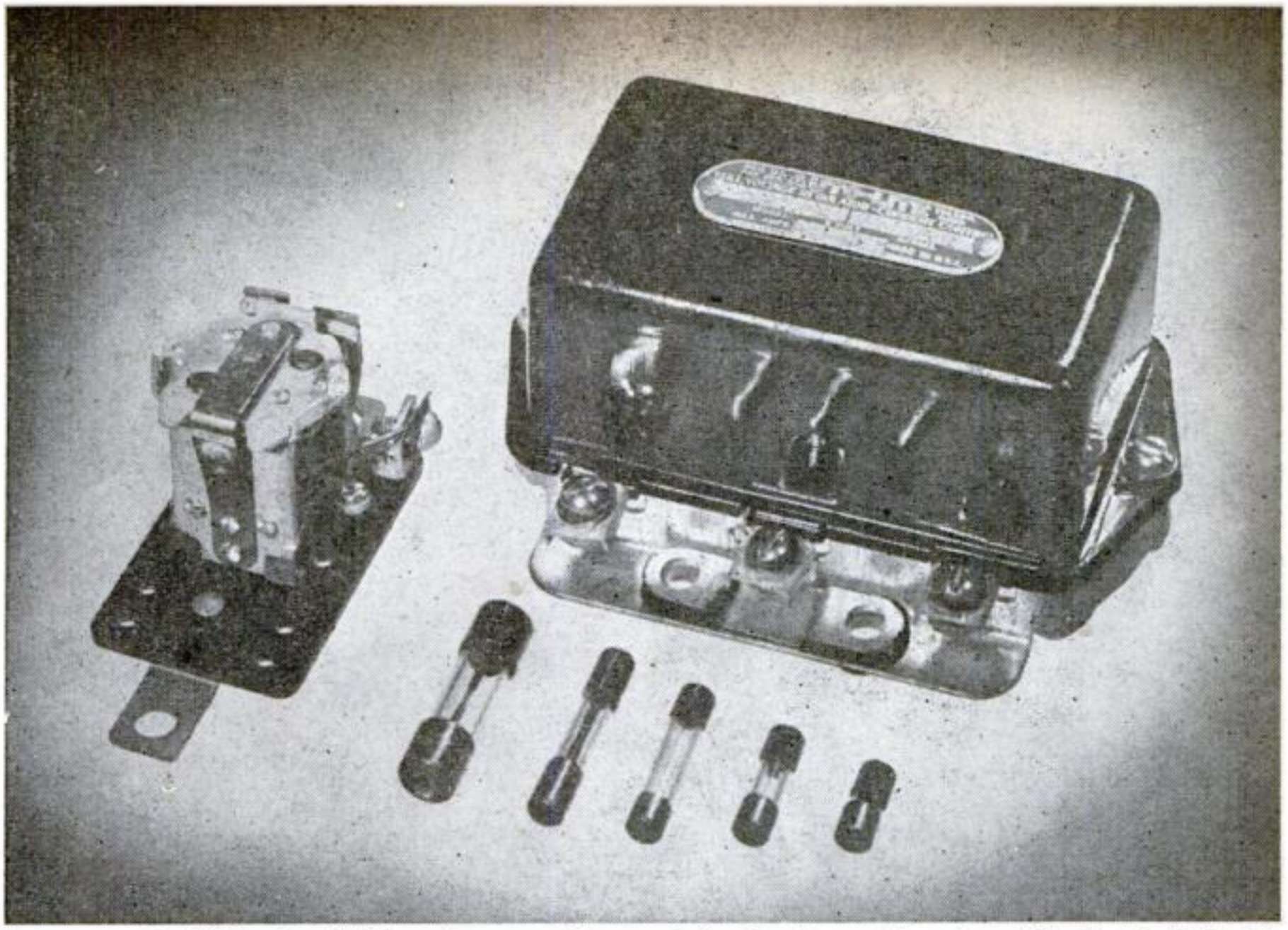








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Fuses or a circuit breaker (left) and a generator regulator stand guard in automobile electrical circuits.

# Electrical Safety Valves Protect Your Car

By WILLIAM H. CROUSE

AUTOMATIC controls are as essential to the electrical system of a car as a safety valve is to a boiler. In the absence of fuses or circuit breakers, short circuits could cause serious damage or fire. Without such protective devices as voltage and current regulators, both the generator and battery would be constant troublemakers.

A cutout relay, a voltage regulator, a current regulator—the three magnetic switches that usually are designated collectively as a generator regulator—and a number of fuses comprise the main safety valves in the electrical system of most modern cars. In some, circuit breakers or thermostatic relays perform the function of fuses.

There was a time when comparatively small demands were made on an automobile's electrical system, and a third-brush generator could do the job. In these generators, the maximum output is easily controlled by adjusting the third brush. But as electrical accessories were added and the output was stepped up (as it had to be), battery overcharge and high voltage resulted, particularly on long trips. To overcome these tendencies, a system known as step-voltage control was adopted. This consists of a cutout relay and a step-voltage control unit, the latter being a magnetic switch operating much like the former.

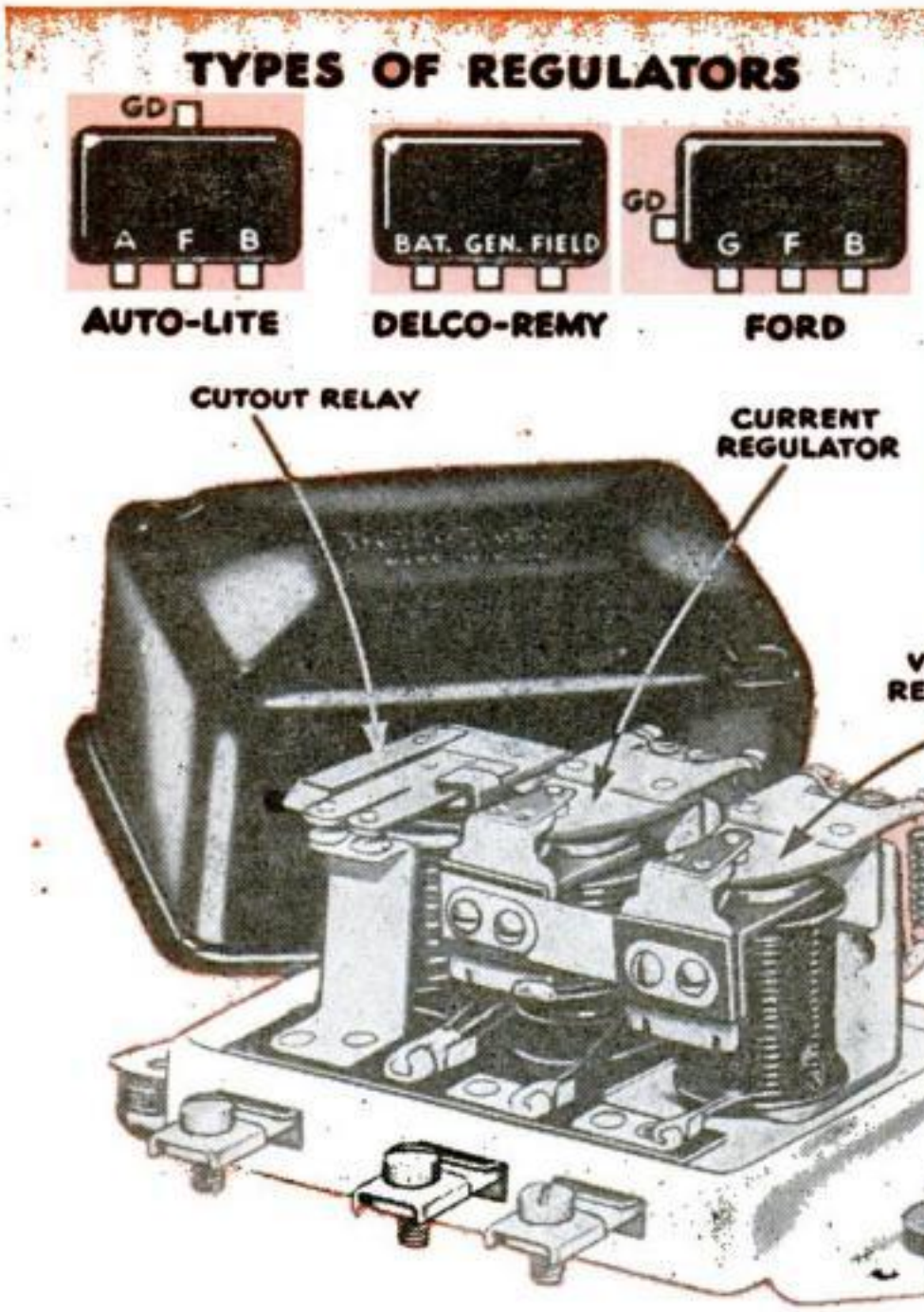
Third-brush generators, however, are slow in reaching their maximum efficiency, and at higher speeds the output tapers off. They have now largely given way to straight shunt generators, with which a cutout relay, a voltage regulator, and a current regulator are usually all employed.

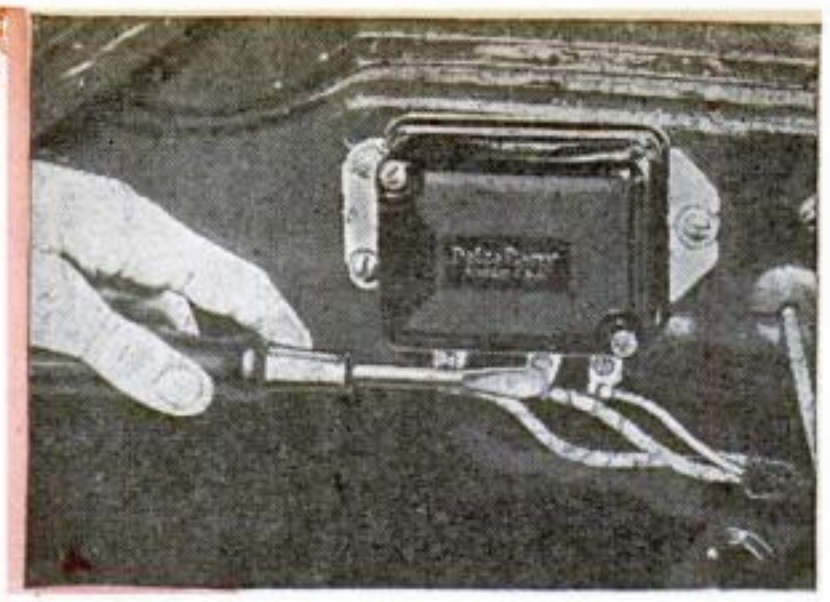
A cutout is the policeman that keeps the generator-battery circuit a one-way street. When the generator is delivering current, the contact points in the relay close magnetically, allowing current to flow to the battery. When the output drops off to the point where current would flow back from the battery, the contact points automatically open. The voltage regulator, as its name indicates, prevents the generator from directing too large a voltage at the battery and overcharging it. Likewise, the current regulator keeps the generator from exceeding its maximum rated output.

Erratic ammeter action, a rundown battery with a low charging rate, and a fully



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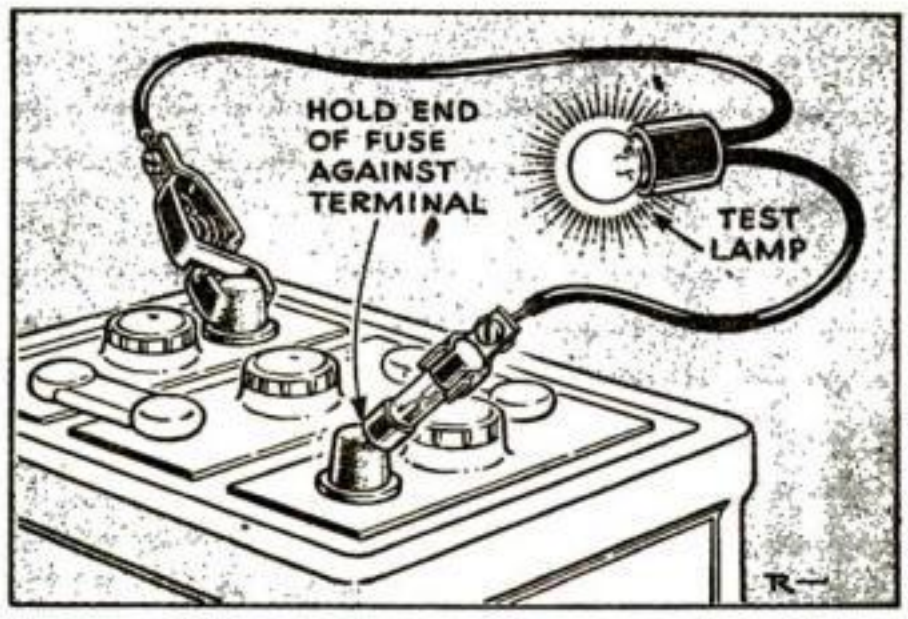
A screwdriver placed across the generator and battery terminals of a Delco-Remy regulator, above, polarizes the generator correctly. As indicated by the drawings at the upper left, a jumper lead is needed for this task on other types.

charged battery with a high charging rate all are likely signs that there is something wrong in the regulator. With a low battery, the charging rate should of course be high. If the rate is low, first check the leads and connections between the generator and battery, for if these are defective a normal charge cannot reach the battery. Clean any corrosion from the cable connections at the battery terminals with steel wool, tighten the cable clamps, and coat the terminals and clamps lightly with vaseline to retard corrosion at these vital points.

If the charging rate remains low, there may be a defect in either the regulator or generator. To determine which is at fault, operate the generator at a medium speed and momentarily connect the field terminal of the regulator to the regulator base or to the generator terminal with a screwdriver or jumper lead, making the connections according to the type of unit. On Auto-Lite and Delco-Remy passenger car regulators the field terminal should be connected to the regulator base for the test, but on Ford regulators the field terminal should be connected to the generator terminal. If the output increases considerably when the connection is made, the regulator is at fault. Otherwise, it probably is the generator.

Many regulators are factory-sealed to discourage random tinkering, for such attempts often cause more harm than good. But in the absence of a trained serviceman, there are some repairs you can make provided you treat the regulator like the delicate instrument that it is. (See P.S.M., Nov. '43, p. 128). If you find, for instance, that a half-charged battery is not receiving enough current from the regulator, it may be that cleaning the contact points will clear up the trouble. First, remove the lead from the battery terminal of the regulator to avoid grounding the battery side of the circuit. Then clean the points with a few strokes of a thin, fine-cut contact file and pull a strip of clean linen between them to remove filings. Take care not to disturb any spring-tension adjustment.

Should there be any doubt whether a fuse is good, this testing rig will quickly show whether it is.

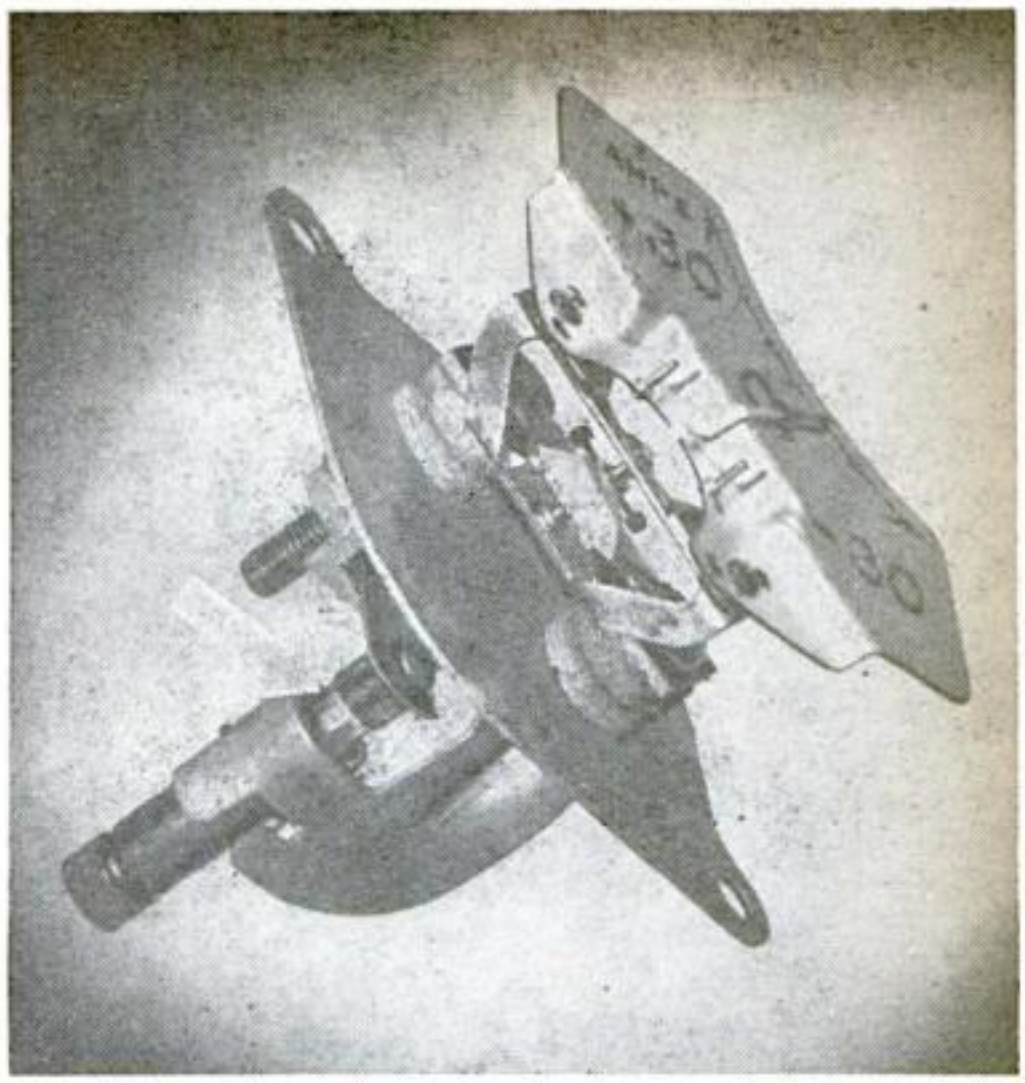





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When the charging rate is high with a charged battery, operate the generator at a medium speed to obtain a high charging rate and then disconnect the lead from the field terminal of the regulator. This opens the generator field circuit. If the charging rate drops off, the regulator has an internal short or ground or is improperly set and will require replacement or adjustment. If the charging rate remains high, the generator probably has a short or ground.

As a final step in any repairs in which generator or regulator leads have been disconnected, it is important to see that the generator has the correct polarity before the engine is started. This can be done by connecting a screwdriver or jumper lead momentarily between the battery and generator terminals of the regulator after all leads are connected. This permits a brief flash of current to flow from the battery through the generator and polarize its field magnets correctly.



Your dash ammeter probably will serve notice of defects in any low-voltage circuit. Above, the arrow points to the fuse.

Two types of fuses are employed in motor vehicles. Some are visible in glass tubes. Others are enclosed in fiber cartridges. The visible type is used primarily in automobiles and the others in trucks or buses.

In general, lighting and accessory circuits are fused. Therefore, when either the lights or accessories fail to function there is a possibility that a new fuse is required. When a fuse blows it is only common sense to investigate before replacing it, for the mere fact that this has occurred shows that something is wrong. Whatever it is, the trouble should be corrected before the new fuse is installed.

In addition to preparing for trouble by carrying a spare fuse or two, the car owner can help forestall it by a periodic check of all the wiring to see that contacts are secure and that corrosion has not occurred. At the same time, check over the wiring, with particular attention to places where the insulation may be abraded.

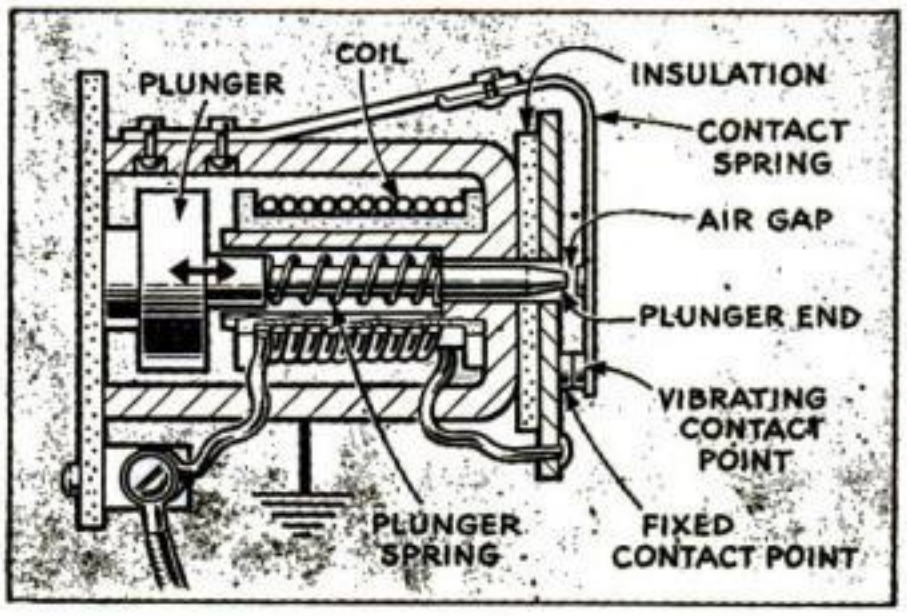
In buses and trucks, thermostatic relays or circuit breakers (also called current-limit relays) sometimes perform the work of fuses. When there is excessive current, the bimetal blade of a thermostatic relay warps, opening the circuit. When it cools, the circuit closes. This repeats until the condition that causes it is corrected.

Two types of circuit breakers are used, vibrating and lockout. Both are of similar construction. When a heavy flow of current occurs, the iron core of the circuit breaker is magnetized, causing it to attract the iron armature and separate the contact points.

In the vibrating type, this cuts off all current momentarily, the points return to contact, and the process is repeated, causing a warning clicking sound. In the lockout type, there is an additional high-resistance winding around the iron core, the ends being connected across the contacts. Hence, when a heavy flow of current magnetizes the core and the armature is drawn against it, the magnetic field of the fine wire keeps the armature in place and the contact points separated. A small amount of current continues to flow through part of the shorted circuit, but serious damage is prevented.

Both types of circuit breaker are sometimes used on the same car, the vibrator being connected in the lighting circuit and the other in the circuits to the accessories.

If a short circuit puts a vibrating circuit breaker into action, its audible clicking warns of trouble.






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# Stan and a Schoolmarm

By MARTIN BUNN

STAN HICKS, the Model Garage grease monkey, stopped whistling as he completed the minor job he was doing, and with a note of preoccupation said: "It's funny."

Gus Wilson looked up from another job. "What's funny?" he asked.

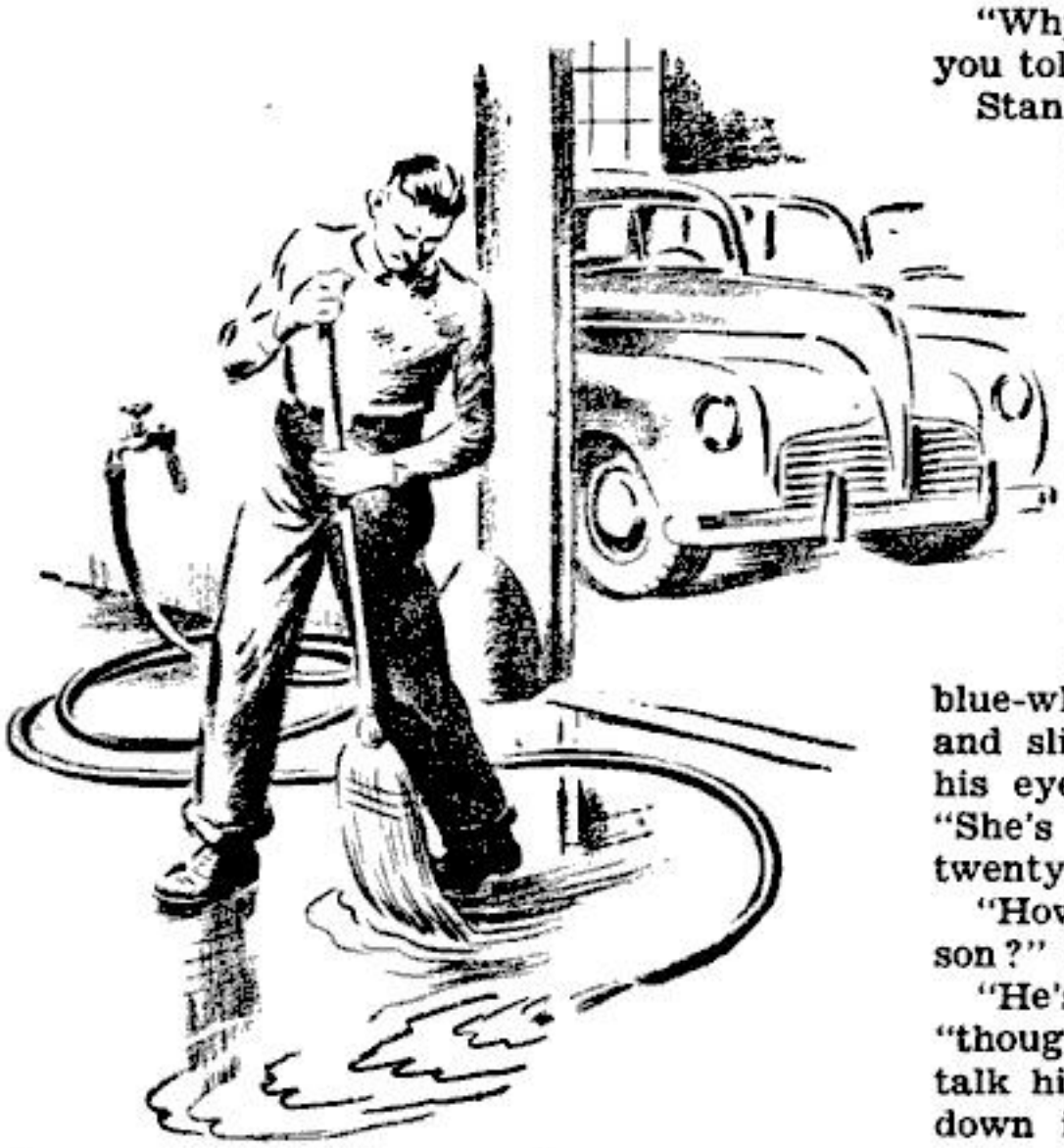
"I was just thinking," Stan explained.

"That *is* funny—and dangerous, too," Gus cautioned. "It's a habit that could grow. But I guess you needn't worry."

Stan grinned at his employer. "I was just thinking," he went on, "how different things are now from a year ago. Then pretty near every customer wanted us to do something to make his bus last forever. Now pretty near everyone wants us to do something to make it go faster."

"Well, why not?" Gus said. "A year ago the speed limit was thirty-five miles, and almost everyone was patriotic enough not to exceed it. Now we've got prewar speed limits back, and even if most tires aren't all they should be, most people want to travel at the legal limit. That's only natural after all."

"Maybe so, boss," Stan conceded, "but what *is* funny is who some of the people are." He pointed at a 1940 sedan near the shop door. "That job was brought in while you were out to lunch. Know whose it is?"



Gus glanced at the car. "Of course—it belongs to Miss Flagstone, the school teacher," he said. "What's the matter with it?"

"She's coming in after school to tell you all her girlish troubles," Stan said, grinning. "But her big gripe is that it don't behave nice when she gets it up over fifty." He looked at Gus with a what-now expression on his callow face. "Imagine, boss—an old white-haired lady like her!"

Gus jumped as if a wasp had tagged him.

"What d'ya mean, old lady!" he yelped. "Why, Miss Flagstone's younger than I am—and she's got ten times more get-up-and-git in her than any of you young false-alarm fireballs!"

Stan's grin widened. "I didn't mean anything personal. Anyhow, you're different—sort of," he said tolerantly. "Why, Miss Flagstone was my teacher in the eighth grade, and even then she had gray hair and we called her Old Lady Flagstone!"

"That proves she had fresh kids in her class," Gus growled. "Get the hose and a broom, and harness that flaming youth of yours to the job of cleaning up the driveway."

Stan, the sweat of honest if unwilling toil streaking the grime on his face, was busy in the driveway when Miss Flagstone got out of a taxi. He pretended not to see her, but she wouldn't have it that way.

"Why, Stanley," she exclaimed, "I thought you told me you were a *mechanic.*"

Stan's face got redder. "S-so I am, ma'am," he stuttered. "But even a m-mechanic has to do jobs like this once in a while. You can't expect—"

"Of course, you can't," Miss Flagstone agreed sweetly. "Is Mr. Wilson in?"

"Yes'm," Stan told her with politeness in his voice and murder in his heart. "He's in the shop."

Miss Flagstone went in. Gus, who has known her for a flock of years, regarded her with freshened interest and didn't find her crisply waved blue-white hair, fresh-complexioned face, and slim tweed-clad figure at all hard on his eyes. "Old lady!" he said to himself. "She's better looking now than she was twenty years ago!"

"How's my friend Stanley doing, Mr. Wilson?" she inquired.

"He's doing all right," Gus told her, "though he'd do it a lot faster if I could talk him into taking an automotive course down in the city three evenings a week.



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# Teach Gus a New Trick

But he says that when he gets through his day's work here he's too tired to drive to the city. Except for that, he's doing fine. He's going to develop into a real mechanic some day."

"Stanley was one of my pet pupils," Miss Flagstone said, "but I soon found that he needed sitting on every so often. He still does—and I've just sat on him again."

"Good for you!" Gus applauded. "So have I. That dumb-and-dirty job he's doing outside is a form of sitting on that I save up for times when he shows signs of getting too big for his boots. . . . Well, what's the trouble with your car, Miss Flagstone?"

"*You'll* have to tell *me* that," she said. "My guess is that during the war it got out of the habit of running over thirty-five and can't readjust itself. Whenever I try to drive over fifty the motor misses and sputters, and sometimes the car bucks hard."

"Have any trouble starting?" Gus asked.

"Yes," she admitted. "The same thing happens in both low and second when I try to make a fast getaway when a light goes green. It doesn't make much difference driving to and from school, but beginning tomorrow I'm doing what you want Stanley to do—taking a—well, a course down in the city. I have to be there by six o'clock two days a week, and as I seldom get away from school much before five I'll have to step on it."

"So that's it," Gus said. "When I tell Stan you're





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taking a course, it may shame him into doing the same. If you can do without your car until tomorrow afternoon, I'll have it at the school before five."

GUS had the best intentions, but rush job after rush job came in, and about four the next afternoon he woke up to the fact that he'd done nothing on the car.

"Hey, Stan!" he called. "Help me check this Flagstone bus. We've got to get it out in a hurry. Let's see, now—engine misses at high speeds and on quick starts in first and second gear. It could be the coil."

He connected an ammeter in series with the battery and the primary terminals of the coil. The indicator hand moved to the 5-amp. mark, and when the coil had warmed it moved back to 3 amp. and stayed there.

"No ground or open circuit in the primary winding," Gus said. Then with the engine running he held one spark-plug cable near the motor block. A fat, hot spark jumped the gap.

"Nothing the matter with the coil," he decided. "And the condenser seems O.K."

"How about spark plugs?" Stan asked.

"You check 'em." Gus told him. "I'll take a look at the wiring and connections."

The plugs gave good sparks, and the wiring and connections were in A-1 condition.

Gus looked at the shop clock. "Maybe the grief is in the distributor, or maybe it's in the high-speed jet of the carburetor, or it might even be in the fuel pump," he said. "Wherever it is, I'm not going to be able to find and fix it in half an hour."

"Wait, boss," Stan cut in. "I got to thinking about that old gal taking an evening course, and I figured if she can stand it so can I. Tonight's the deadline for signing up for the next term, and I'm going down to the city to register. I could take her with me and pick her up after her class."

GUS went down to the Park House and ate his dinner, and then went back to his shop and retackled the troublesome Flagstone job.

"A worn distributor shaft could be causing the trouble," he reasoned. "If it left the distributor shaft free enough for it to wobble, the cam wouldn't touch the points when the shaft was on the out-wobble."

He disassembled the distributor, but all its parts seemed to be in perfect condition. Next, he checked the carburetor and the fuel pump without result. Nine o'clock found him badly puzzled.

Just then Stan came in. "You're back early," Gus grunted.

"It didn't take long," Stan said. "Miss Flagstone will be in for her car in a few minutes. Got it fixed?"

"No, I haven't," Gus growled. "It's got me pretty well stumped." He scowled at the sedan as he filled and lighted his pipe. After a few puffs his face brightened. "By gum," he muttered. "I'll bet that's it."

He went over to the cabinet in which he keeps his instruments and came back with a spring-type scale. With it he tested the distributor-point springs.

"Ten to twelve ounces," he said, "and they should show at least fifteen."

"What's all this?" Stan demanded.

"Something for you to remember—and I should have remembered sooner," Gus told him. "Weak point springs—one of the very toughest troubles to diagnose. The point springs in this distributor have lost their strength and snap. They don't close as fast as they should, so the coil is robbed of its normal build-up period, and there isn't enough spark to fire the engine."

Stan thought that over. "I get it," he said. "But what I don't get is why the engine misses only at high speeds."

"That's easy," Gus explained. "At low speeds even weak springs have enough snap to close the points promptly on the slower-revolving distributor cam. We'll put in new springs, but we'll test them first. Sometimes new springs haven't strength enough."

Gus installed good new springs—and the engine ran smoothly at all speeds.

"Say, boss," Stan asked, "what course do you think that old gal is taking?"

"Something high-brow," Gus replied.

Stan grinned. "She's taking dancing!"

"What?" Gus asked. "Well, she's got a right to take dancing if she wants to. But she doesn't need lessons. I know—I danced with her at the Town Club's ball."

"Yeah," Stan retorted, "I saw you. You were good, too—in a slow sort of way."

Gus reddened. "I can waltz and fox-trot well enough. But no fool jitterbugging."

"You're missing something!" Stan told him. "Now, you take the samba—"

"You take it—and welcome," Gus said.

"Now, lookit," Stan insisted, demonstrating. "Left foot forward—right foot farther forward—left foot sideways—right foot over beside it—left foot—"

Gus did the step. "Nothing to that."

"Oh, Stanley's showing you all *wrong!*" Miss Flagstone's voice said from the shop door. "Watch! It's *this* way! But you need music. Switch on my car radio."

TWENTY minutes later the door opened again, and Joe Clark came in. "I saw the lights," he said. "I didn't expect *this!*"

His face split into a wide grin, and as Gus and Miss Flagstone whirled past him he tapped his partner's shoulder.

"Excuse me," he said. "I'm cutting in."



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# MECHANICS AND HANDICRAFTS



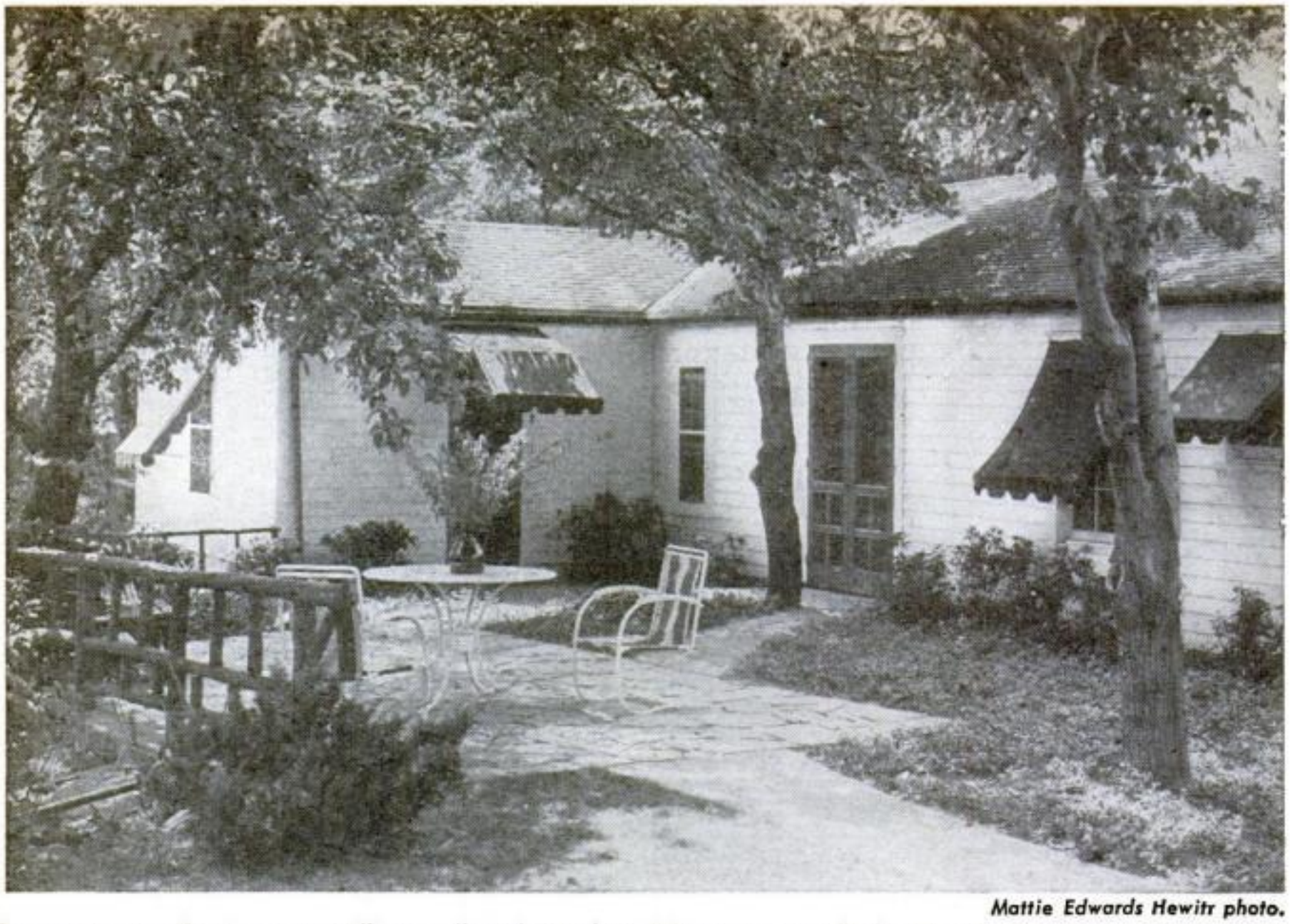









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*Mattie Edwards Hewitr photo.*

**Terraces are effective on small as well as large lots. This one was built up at the edge of the plot.**

# An Extra Room *Outside*

MANY a new home is being planned with an adjacent terrace at front, on one side, or in the rear. Architects and home buyers alike see it as an additional room—roofless for outdoor living—and the terrace is often designed to fit the architecture and to match or blend with the house proper. Older homes do not always have such an "outside room," but given a level spot near the house, or a spot that can be leveled, the omission is easy to correct.

If the terrace site has sun, air, and a certain amount of shade and moisture, its surfacing may consist of a good plot of tough grass, possibly obtained by fertilization, mulching, and extra seeding and care of your present lawn. Grass has some disadvantages, though, especially since it cannot be used for some hours after a rain. It may also stain clothing; and dogs and children will dig in it.

The next simplest surface is gravel or bluestone of the kind used for suburban driveways. It requires no care beyond once-a-week raking over and occasional renewal, is simple and inexpensive, is readily obtained, and has a pleasant appearance. When maintained at a depth of $1\frac{1}{2}$", it will keep down grass and other growth. But furniture cannot be dragged across it without making deep marks that need to be smoothed out, and it cannot be used freely by children, since a fall in a running game is sure to bring badly cut knees and hands.

Bricks make a good terrace and need not be expensive if a quantity of old bricks is available. Set the old bricks in to alternate with new ones. Bricks may be laid close together as in a wall or with open space between for grass, and the patterns are limitless. When there is planting between bricks, it is well to have a solid brick edge and a central solid spot. The grass-and-

## CONCRETE-FLAGSTONE MIX

For a base course, use a 1-2-4 mixture with coarse, clean gravel as aggregate; for surfacing, 1 part cement and 2 parts fine sand.

The surfacing coat may be colored with special cement colors or ordinary dry Venetian red, burnt umber, yellow ocher, or other powder mixed in dry before the water is added.



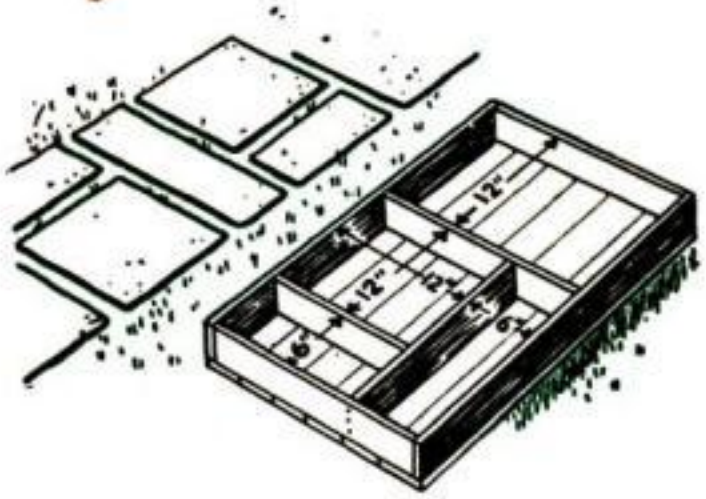
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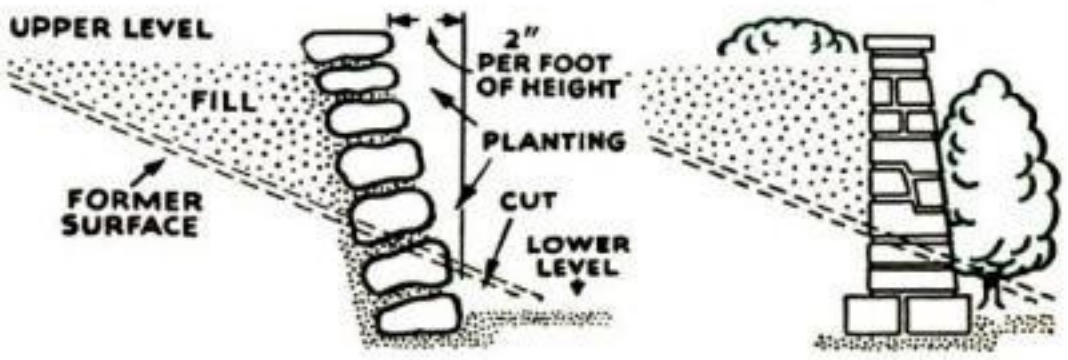
As a set of flags hardens, the metal strips are moved to make new forms.



This narrow side yard lends itself to simple terracing with a flagstone flooring. The house itself furnishes needed shade.




Wood forms should be well oiled. The flags are made and then set in place.




Level ground for the terrace can be built up from a slope with a retaining wall of field stones (left) or cut stones (right).

# the House

By MORRIS A. HALL

brick arrangement may then be utilized in the intervening spaces.

Tiles can be easily obtained in many colors and are as readily laid as bricks. The most permanent results are had by bedding them close together in a ½" to ¾" layer of cement. Work from the house outward and, with a hammer and pressure of the hands, tap each new tile level and in toward those already laid. A pleasing effect is possible when colored cement is used and the tiles are embedded deeply so the cement will come up between them as a series of colored lines. Red tiles are harmonious with a red-brick house or contrast well with white stucco. Other colors may be chosen, or several colors may be used in a helter-skelter pattern. Neither the pattern nor the colors should be too aggressive, however, for a terrace is intended to be a restful place.

In random shapes and sizes, or cut to exact size, 1" thick slate can be obtained at a building-supply firm by the square yard. It can be as effective in a small terrace as it is in a walk. If the home has a slate roof, or if the general effect is soft grays, mild reds, or a combination of the two, slate is most suitable. The handyman lays the pieces in dirt, grass, cement, or 1" or so of sand. Colors available are gray, dull red,

## PLANTING BETWEEN FLAGS

Arenaria verna, resembles moss, for narrow spaces.
Mazus reptans, tiny creeper from New Zealand.
Moss, in any of the hundreds of types.
Thyme, veronica, and linaria varieties.

If grass is used, take care to eliminate tall-growing varieties such as timothy and redtop and the weak, pale types like Italian rye.

## WALL-POCKET PLANTS

Tunica saxifraga.
Nepeta mussini.
Cerastium tomentosum.
Phlox, dwarfs.
Santolina incana.
Teucrium chamaedrys.
Lavandula vera.
Iberis sempervirens.
Daphne cneorum.
Rosemary and other shrubs.

Fill spaces between stones with topsoil.

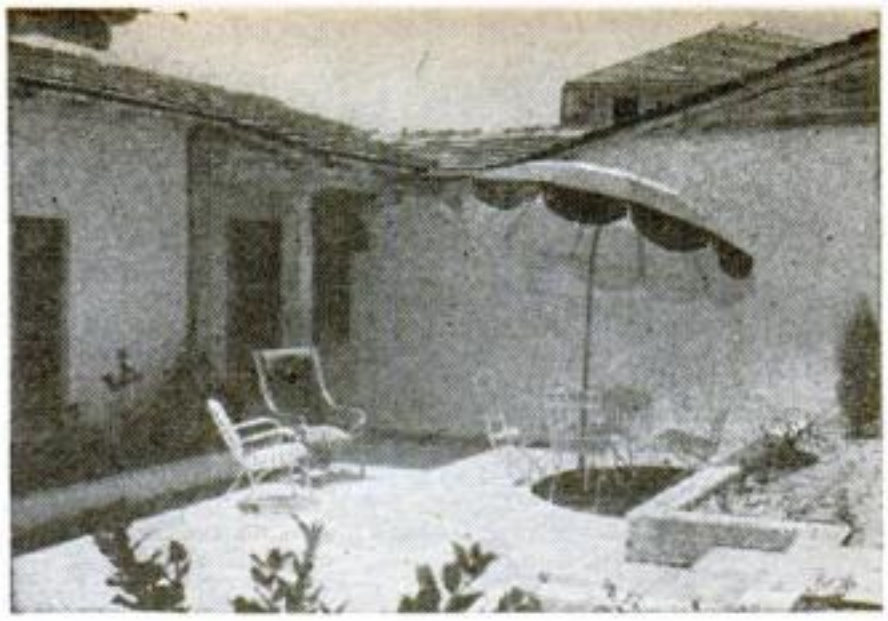


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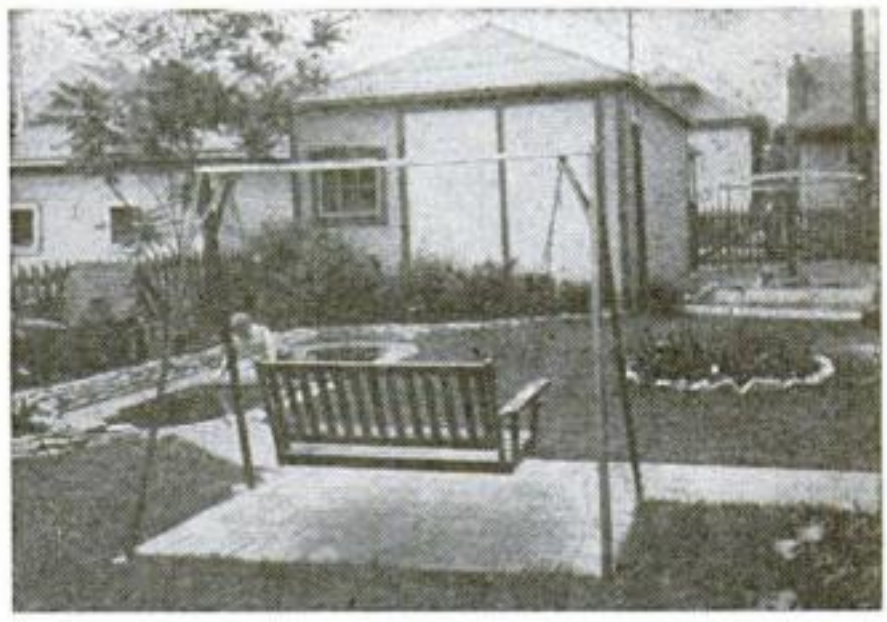
*Mattie Edwards Hewitt photo.*

Shade from a sprawling apple tree cools a terrace of flagstones that fills an angle in this house.



Cemented flags blend with the stucco house here. A low wall separates lounging space and garden.

Even a small city lot can be dressed up. Below, a wading pool, sandbox, and terrace for a swing.



green, an occasional bright red, and modifications. Slate is easy material to handle, especially in large sizes. It can be bedded down in irregular patterns with 2" of grass between pieces, or the stones can be matched and dirt put between them.

Large, flat field stones are a similar material. They can be collected in some vicinities or bought from a mason's supply company. Most stones are 2" to 3" thick, and they come in sizes up to that requiring two men to handle. Collected stones may be somewhat rough, but bought flagstones are usually sawed fairly smooth on both faces.

Much less work than collecting stones, and cheaper than buying them, is molding flagstones of concrete. These may be poured right on the site or made up in separate flags that can be handled just as are field stones or slate. Two forms for such slabs are shown in the drawings on page 147. One is of wood and makes flags in four convenient sizes with straight, even sides for arrangement in a variety of patterns. The other consists simply of several strips of light-gauge sheet metal that can be bent around stakes in random shapes.

Concrete flagstones require a fairly coarse base 2½" to 3½" thick on which is poured a smoother cement-and-sand surface coat ½" or so thick. This surface coat can be crowned so that water will not collect, and it can be colored with special cement pigments or other color powders. Room is left between the flags for grass.

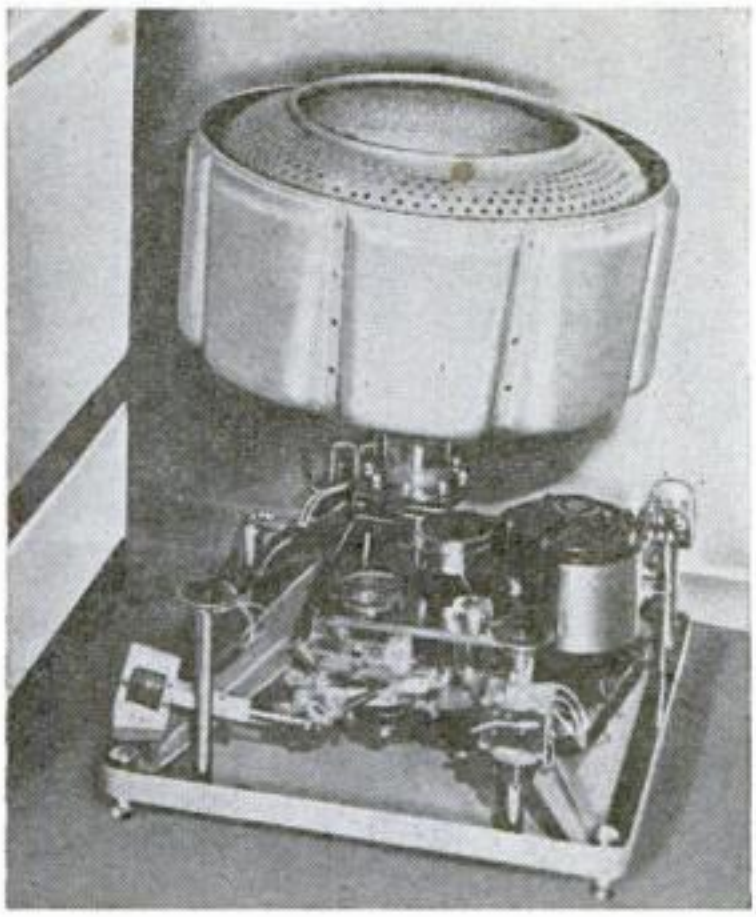
In the case of a house on a steeply sloping lot, it is still possible to construct a terrace, but some sort of retaining wall will be needed to hold back the fill. Two are shown on page 147, one of rough field stones and the other of neatly arranged cut stones. A fieldstone wall provides additional space for growing plants if wide pockets of dirt are left between the stones. If the top of the retaining wall is much more than 3′ or 4′ above the lower ground level, it is well to continue it a little higher than the terrace to serve as a low fence.

For privacy and quiet, a terrace is most desirable in the rear of a house, but front and side terraces can often be secluded by shade trees and shrubs. Southern and eastern exposures are frequently the coolest on late summer afternoons.



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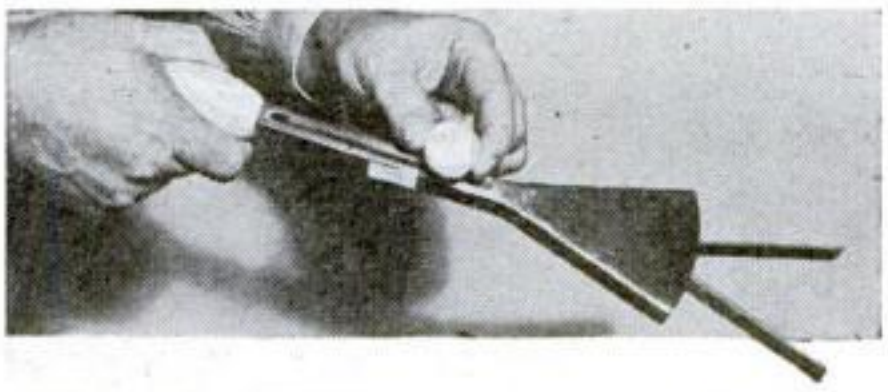
# modern living






**BOUNCING THE WASH** instead of spinning it is the action of the new Apex automatic washer. The machine, made by the Apex Electrical Manufacturing Company, of Cleveland, takes clothes through a four-cycle process of washing, rinsing, damp drying, and "fluffing." It is in the washing cycle that the basket shown in the photo bounces the clothes as baffles tumble and turn them. The bouncing process is repeated in the fluffing stage. During the rinsing, bouncing and spinning alternate.

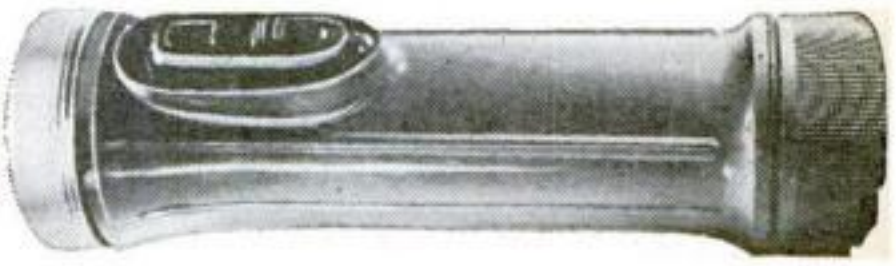
The machine rests on feet that are hydraulically linked so that the washer is self-leveling. An automatic switch stops all action when the lid is raised.



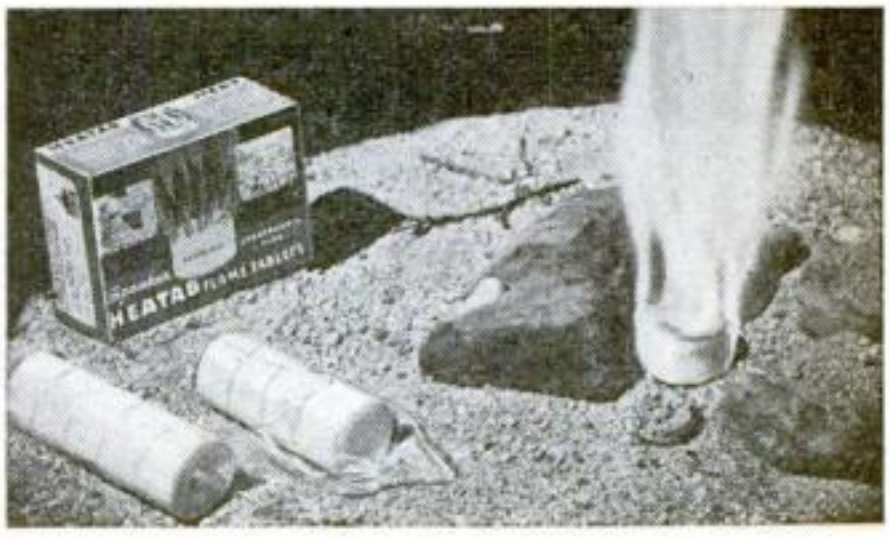
**PIE A LA MODE** may now have its ice-cream wedge shaped to fit the conventional slice of pie, thanks to the Crosby Foundation, of Hollywood. The scooper shown above, an invention sponsored by the foundation, dips up ice cream of the correct size and shape.



**TABLETS OF HEAT** 1½" in diameter by nearly 1" thick and with a burning time up to 35 minutes are now being made by the J. W. Speaker Corporation, of Milwaukee. The tablets have many uses, including starting coal fires and bonfires of damp wood, preheating stoves or torches, boiling liquids, and warming hands.



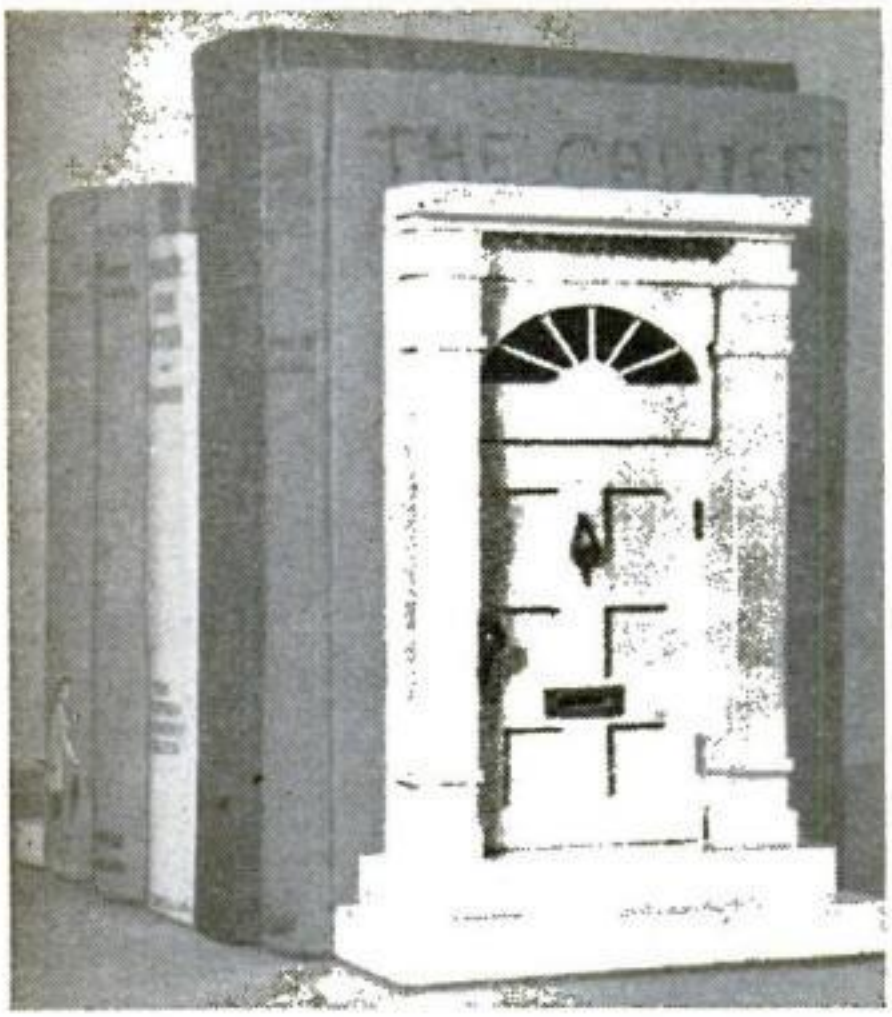
**SEALED AGAINST WATER,** this flashlight operates in rain, fog, and salt air. Body and ends are of plastic with rubber washers fitted between them to keep out moisture. Usona Manufacturing Company, Inc., of Toledo, makes the lamp in a two-cell size with a three-position switch.

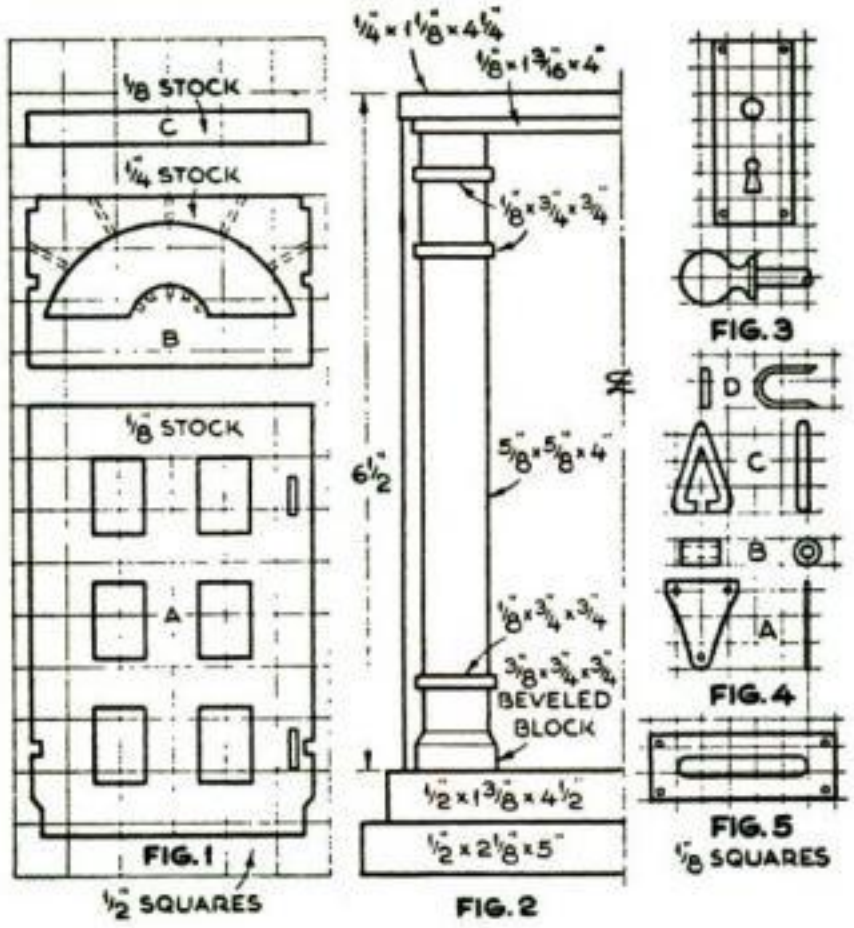





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# Door-to-Knowledge Book Ends





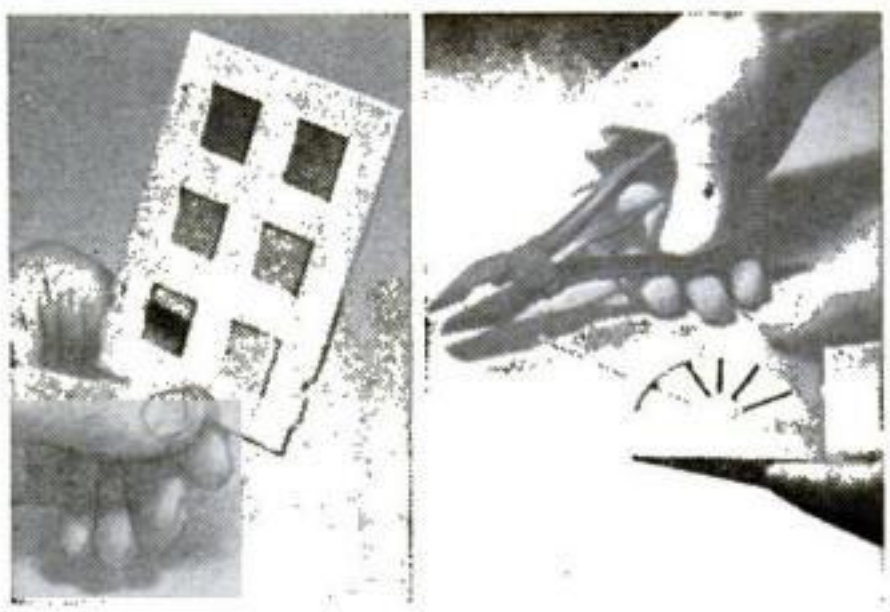

By CHARLES and BERTRAM BROWNOLD

THESE unusual book ends can be made entirely with hand tools. The door for each end may be of plywood, cigar-box stock, or other thin wood. It is shaped as shown at *A* in Fig. 1 with six rectangles cut out to give the appearance of paneling when the piece is glued against a backing. Two slots near the edge take bits of scrap metal, inserted after assembly and painting, to represent hinges. Cut the opening in fanlight *B*, drill radially from the edges as indicated by the dotted lines, and force in short lengths of wire. *C* is a filler strip to be glued in above the fanlight.

The steps, pillars, and lintel (Fig. 2) are glued and bradded together and to a ⅛" by 4¼" by 6½" backing piece of thin wood or plywood, or glued and clamped without brads, and the other parts, with the exception of the fanlight, are fitted and glued in place. Paint the space behind the fanlight dark and the rest of the assembly light; then paint the fanlight the same light color, glue cellophane on its back, and glue it in place when the paint has dried.

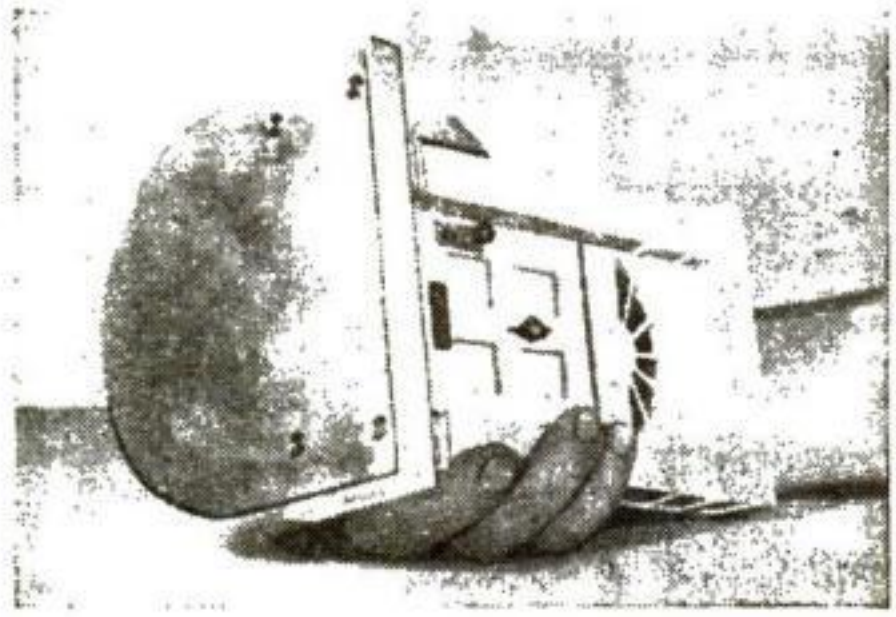
Hardware is cut from thin sheet metal, except for the doorknob (Fig. 3), which may be the pin from a small hinge. The knocker (Fig. 4), consists of the strike *A*, which is held to the door with three escutcheon pins, the hammer parts *B* and *C*, and the holding staple *D*. Figure 5 shows the letter drop.

Thin sheet metal cut 5" by 5" and rounded to a 2½" radius at one end makes a base.



Rectangular holes in the door, as shown at left, provide an effect of paneling when the backing is glued in place. At right, short wires are forced into the fanlight and filed smooth at the edges.

Sheet metal rounded at one end provides a base to slip under the books. Countersink screws in it.





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# A Hobnail Lamp from Common Parts

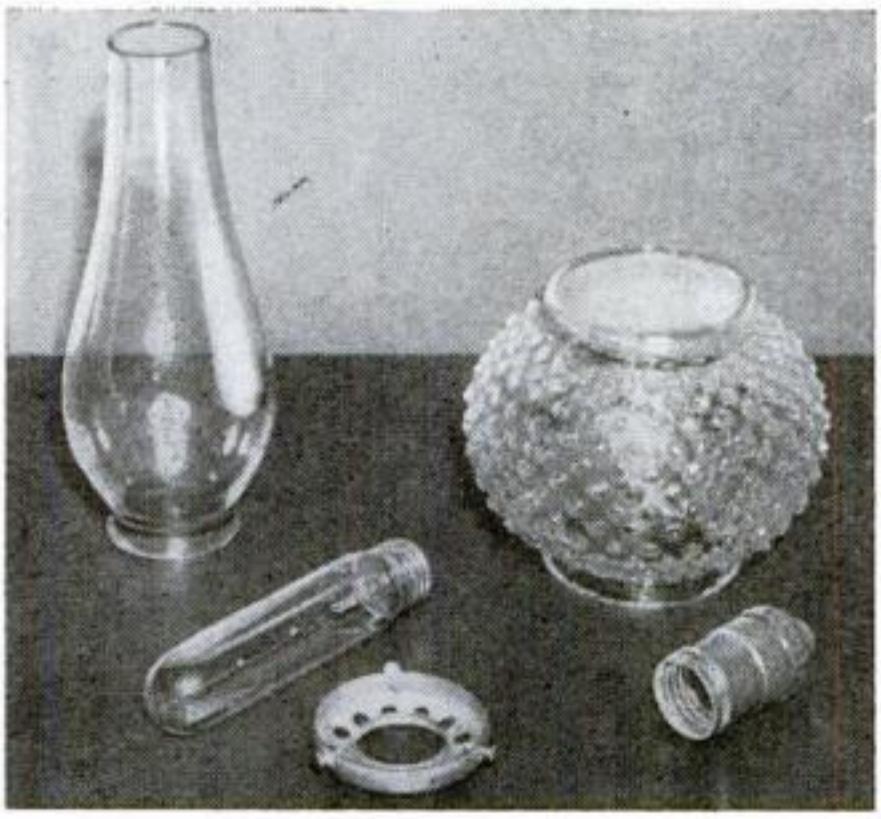
By JOHN J. GALLIVAN

ONE of those old-fashioned hobnail globes used on porch lights forms the base for this Colonial chimney lamp. Fitted with a tubular incandescent bulb, the little lamp will provide a soft welcoming light in a reception hall or brighten up a dark living-room corner.

Hobnail globes can be found at mail-order houses and in some hardware departments carrying electrical equipment. The globe is used inverted with the bottom cut off at the dotted line shown in the drawing so there will be an opening at both ends. A method of cutting the glass is detailed in the drawing. Be sure to leave a lip or flange in cutting the glass so the brass collar can be slipped over it.

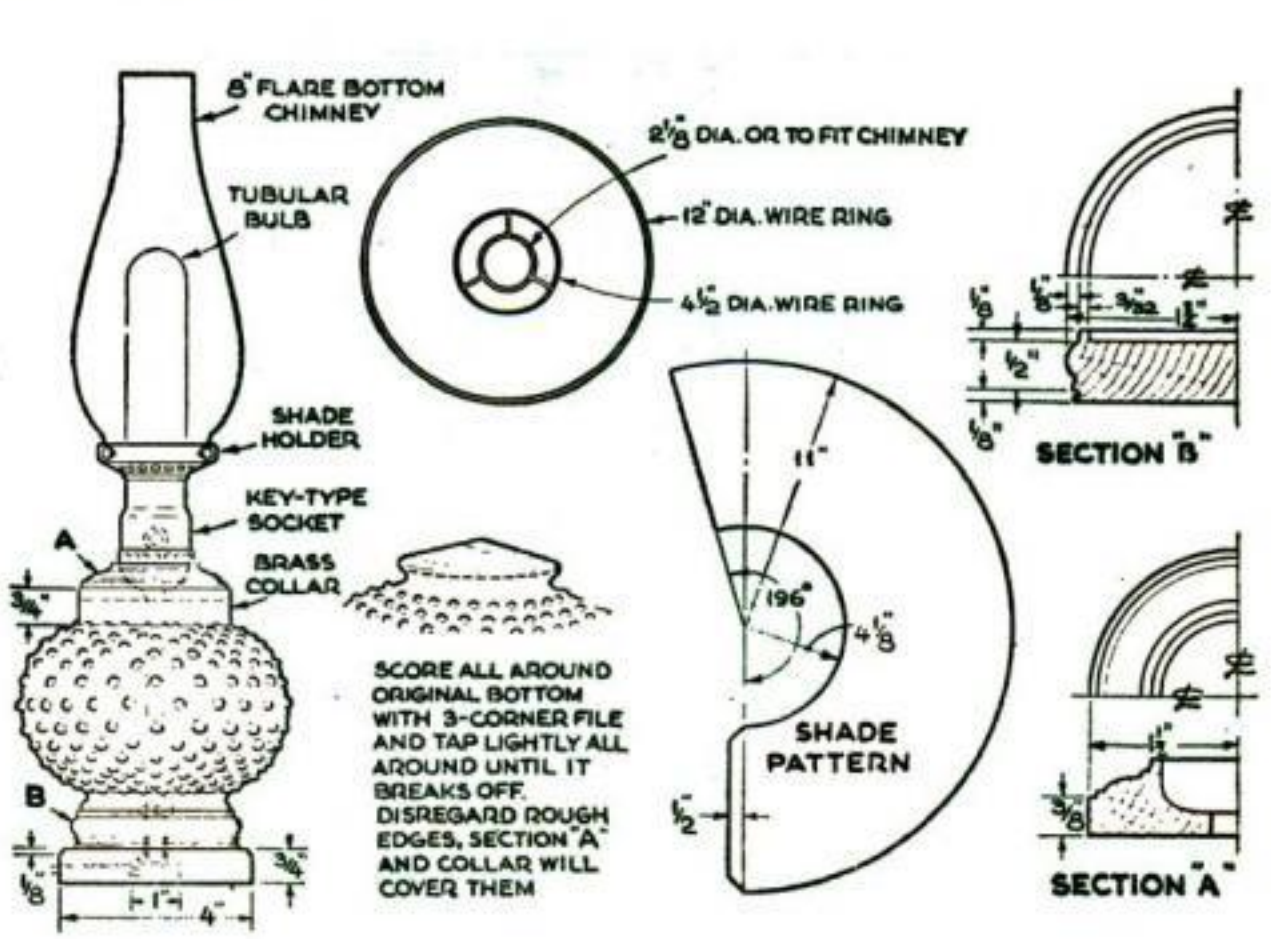
Paint inside the globe to harmonize with the room. Ordinary show-card color dries quickly and is extremely opaque. Two coats give a smooth, even finish that is hard to tell from opaque colored glass.

Make the wood turnings *A* and *B*, and then drill *A* for the socket end and *B* for a 5⅝" length of ⅛" running-thread pipe which, with two nuts on the lower end, holds the lamp together. The square base is drilled radially and from the bottom, the 1" diameter hole being stopped at a depth of ½". Finish the wood parts with good-quality gold bronze and clear lacquer. A metal shade holder supports the chimney. The shade may be bought or made as shown.



Colonial charm marks this little lamp. The socket sets well into the wood turning on top of the hobnail globe to lessen height. A holder for a desk-lamp shade screws onto the socket to support the chimney.

Make turning A a force fit in the collar and slip them over the lip left on the globe when the bottom is cut out.






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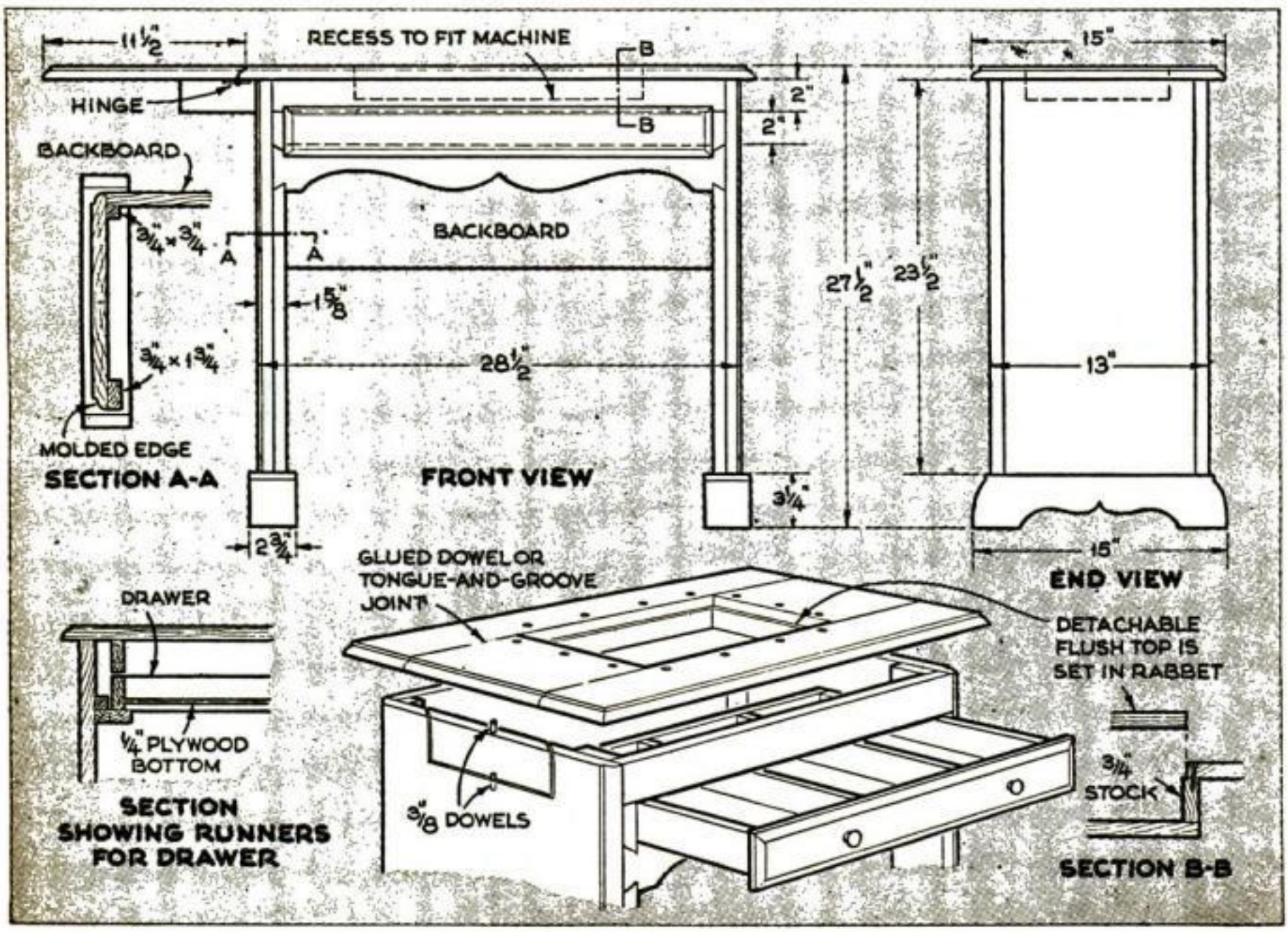
# TABLE for PORTABLE ELECTRIC SEWING MACHINE

WOMEN who use a portable electric sewing machine know the disadvantage of setting it up on an ordinary table. Not only is it difficult to find a table of the right height, but the sewing surface on top of the base is several inches above the table top so that the material cannot be spread out evenly during the work.

The top of this table has a recess, which should be made just large enough for the base of the machine to fit and deep enough for the sewing surface to come flush. It has a drop leaf at the left side that provides additional surface for holding large pieces of material. The leaf is hinged on the underside and is held horizontally when in use by a support pivoted on a hardwood dowel. A shallow drawer holds needles, thread, and other items.



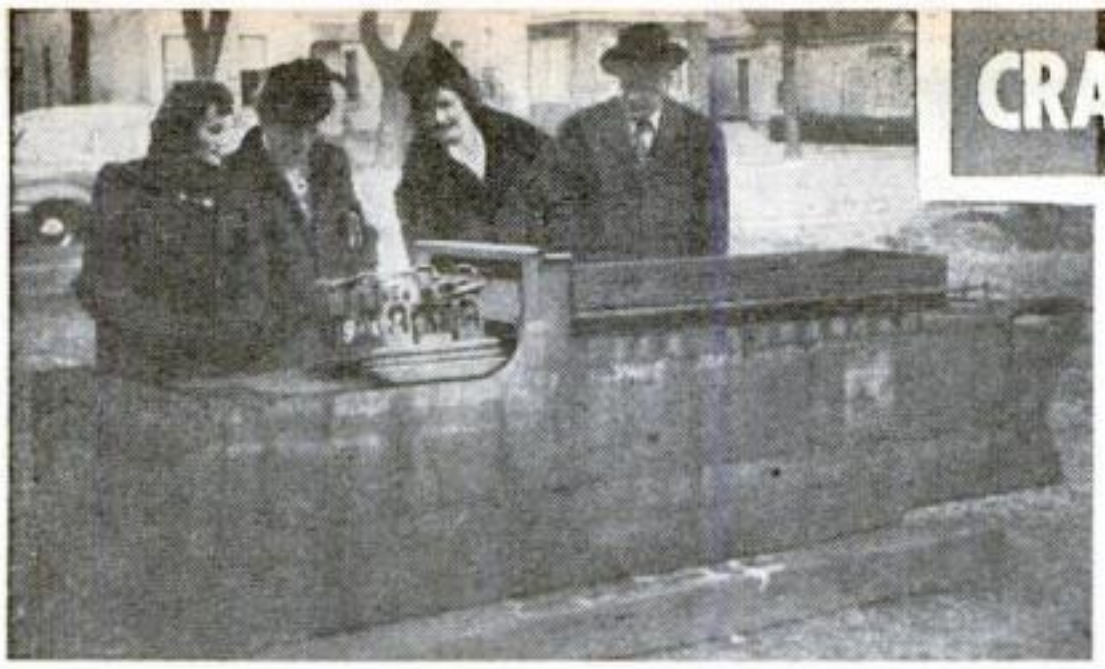
In making the table top, time can be saved if the pieces at the ends of the depression are cut to inside width and two side strips are glued and screwed in place, as shown. A board the same size as the recess may be made to fit in on legs and provide a flush top on desired occasions. All stock is pine except the feet, which should be made of hardwood.—HENRY R. DIAMOND.

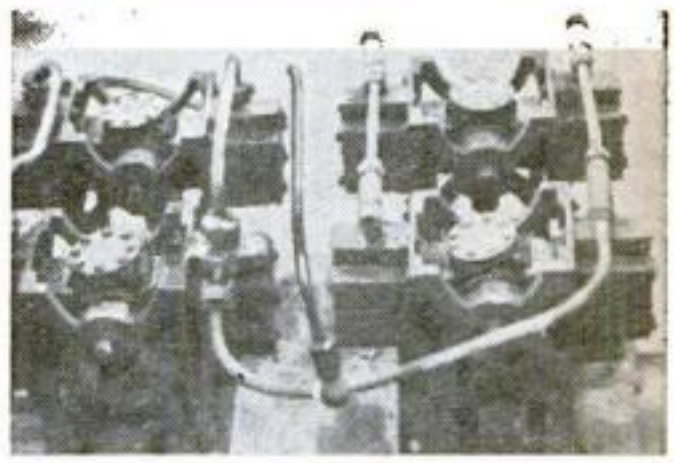





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# CRAFTSMEN AT WORK





**PERPETUAL-MOTION SUBMARINE.** This one-man craft, discovered during the razing of a barn in Springfield, Ill., anticipated the Japs by several years and, to boot, was to have been run by a compressed-air perpetual-motion engine. Alfred T. Markwood, a railroad conductor, who once started a company to make perpetual-motion machines, was its inventor and secret builder. He left Springfield in 1927 for Detroit, where he died five years ago without revealing or launching his strange craft.

The boat measures 3′ in width by 12′ in length and is built entirely of galvanized iron. It was fitted with ballast tanks for use in submerging. Water for the tanks was to have been drawn in at the bow.

At right above is the perpetual-motion engine, made of bronze. Essentially a compressed-air motor, it was to drive two propellers and—on the familiar old lift-by-your-own-bootstraps fallacy—a compressor which in turn was to provide the air to run the engine.

**JEEP IN ACTION.** George McGinnis, of Goshen, N. Y., built the toy jeep shown here from plans in the December, 1945, issue of POPULAR SCIENCE. It's a pedal-propulsion model with many authentic features. "My boy likes it a lot, and many thanks," McGinnis said in submitting the photo.

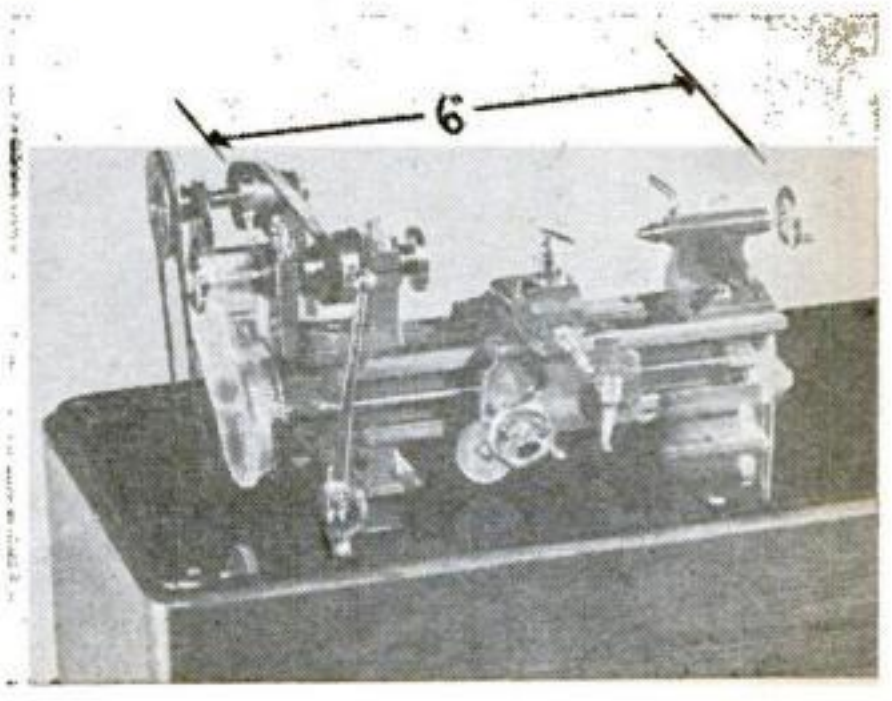


**REAL TURNINGS 2½" LONG** can be made on the miniature lathe shown below. The model, built by L. E. Bussey, of Dayton, retired civilian plane-engine superintendent for the Army Air Forces, has a 6" bed and a swing of 1¾". It is a complete engine lathe in every detail, including power feeds, back gears, and collet chucks of 1/32" to ⅛" capacity. Materials used in construction of the model were conventional—steel, cast iron, and bronze.

The walnut mounting base contains a line shaft and 115-volt motor. In operation, the motor runs continuously, and the lathe is started and stopped by a ball-tipped clutch lever near the headstock. The motor can be plugged into any 115-volt household outlet, and running is noiseless.



**LIQUID NOTES** come from this clarinet made from a length of garden hose and a kitchen funnel. Frankie Hilton, of Pueblo, Colo., used a regulation reed and mouthpiece in order to get music. The hose is holed for fingering.






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A FATHER-AND-SON PROJECT

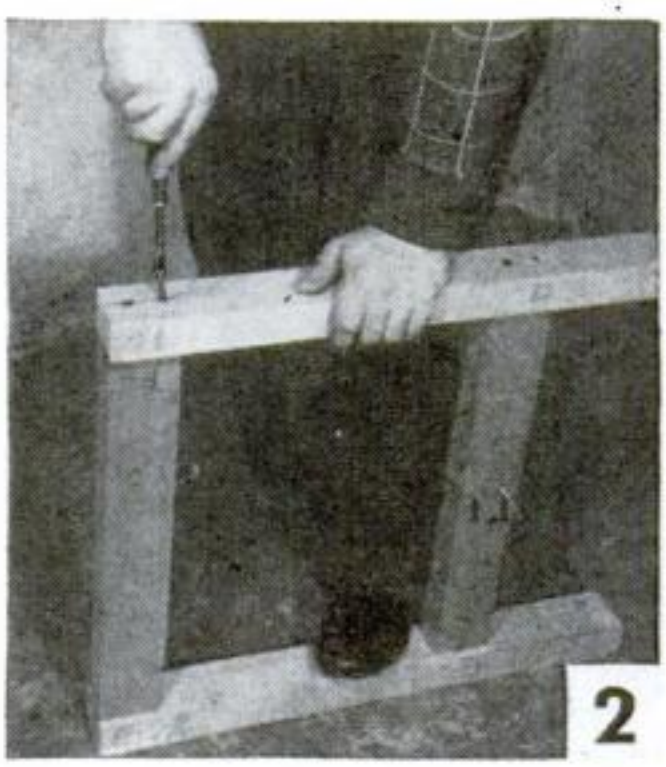
# orkbench for

By PAUL J. ALLEN

YOUR son deserves a good start in workshop practice. There's no better way of providing this than by giving him his own bench, preferably one he has helped build. The bench shown may be completed in a few hours with nothing more than hand tools, yet it will withstand a lot of abuse. It's a good idea to devise ways in which your son may help in its construction, for when you're through the interest thus aroused will help carry him forward.



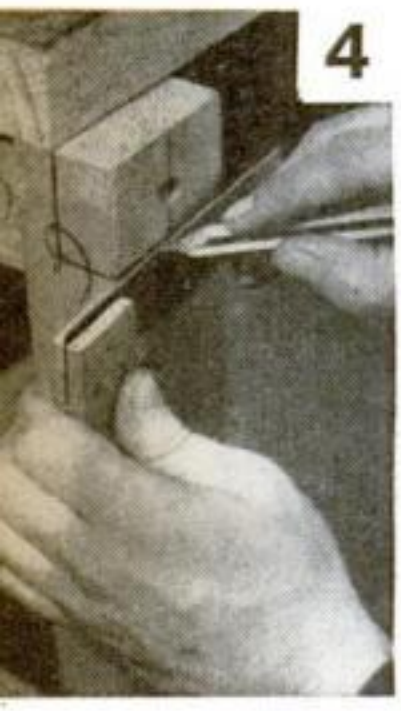

After cutting the legs and rails to length, mark the rail positions on the legs (1). Drill screw holes in the legs with a ¼" drill and in the rail ends with a No. 27 bit, marking all matching parts.




Assemble the ends (2) and fit, drill, and attach the 31¼" stretcher. Top planks may now be placed and installed (3), each corner screw being offset as shown in the drawing to clear the leg screws.



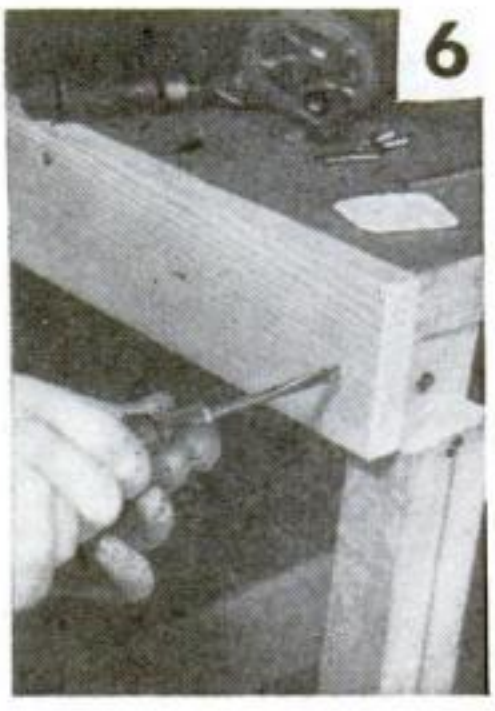

Remove the top screw from each leg, mark the end rabbets (4), and saw and chisel them out. Apply glue to the planks, allow it to become tacky, and put on and weight down the composition board (5).







Side aprons are attached (6) with the upper edges a little above the composition board and the ends protruding so they can be sawed (7) to give tight joints. Plane the edges even with the bench top.



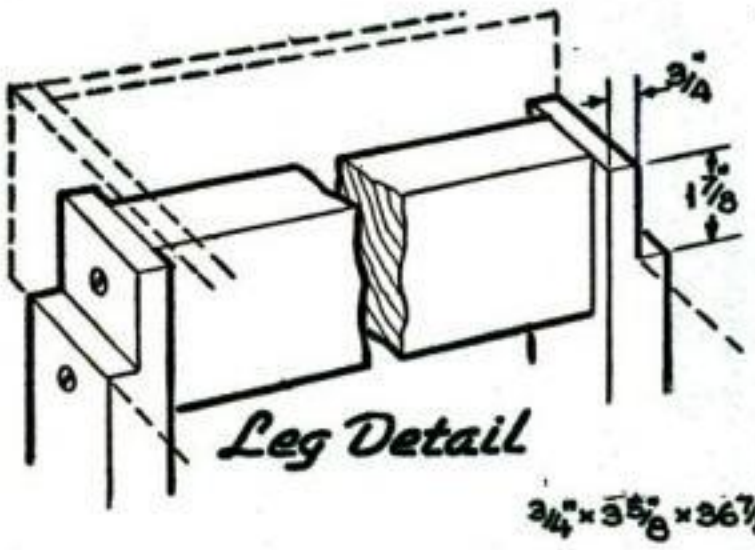




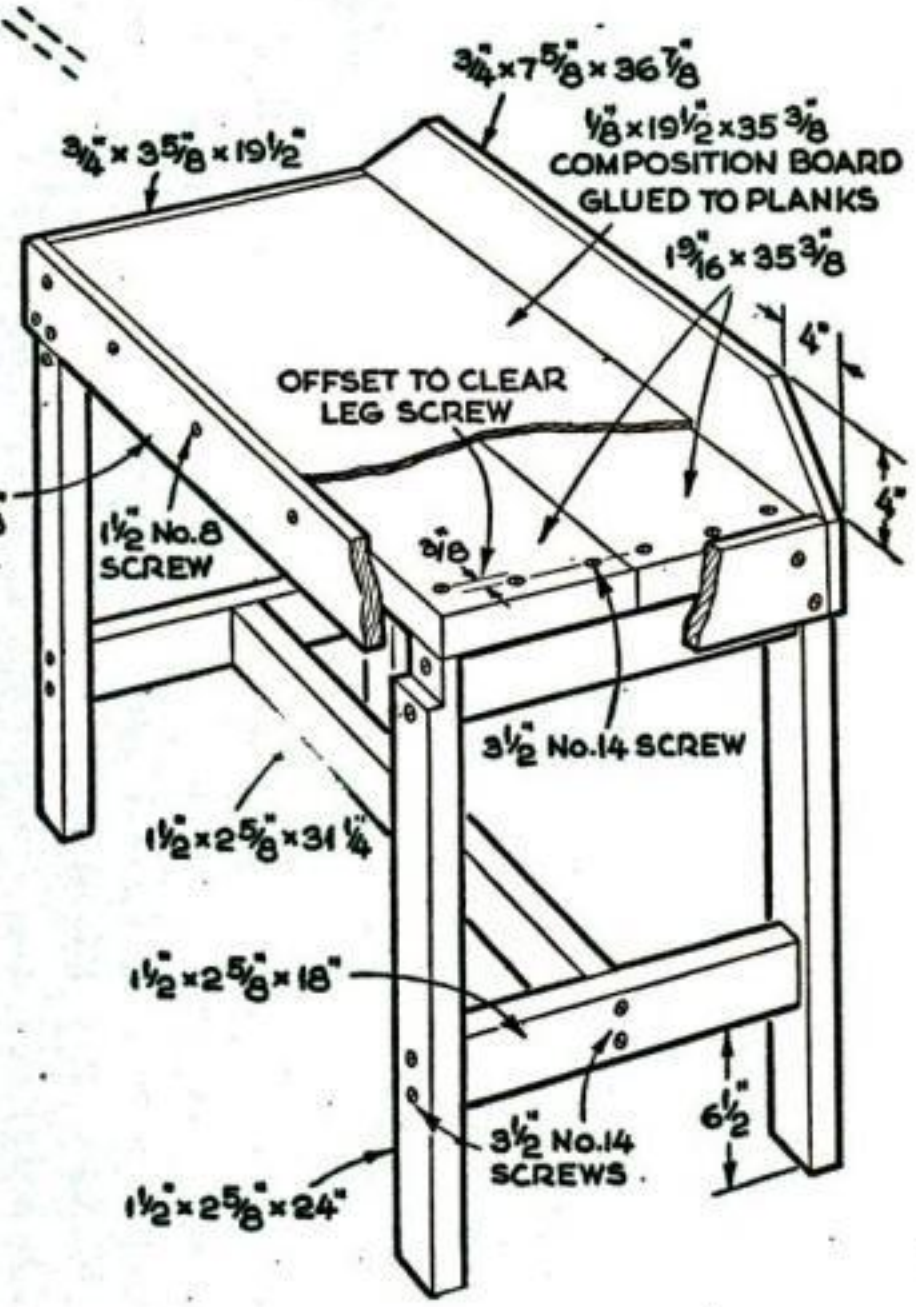


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# the Young Carpenter




*Leg Detail*




## LIST OF MATERIALS

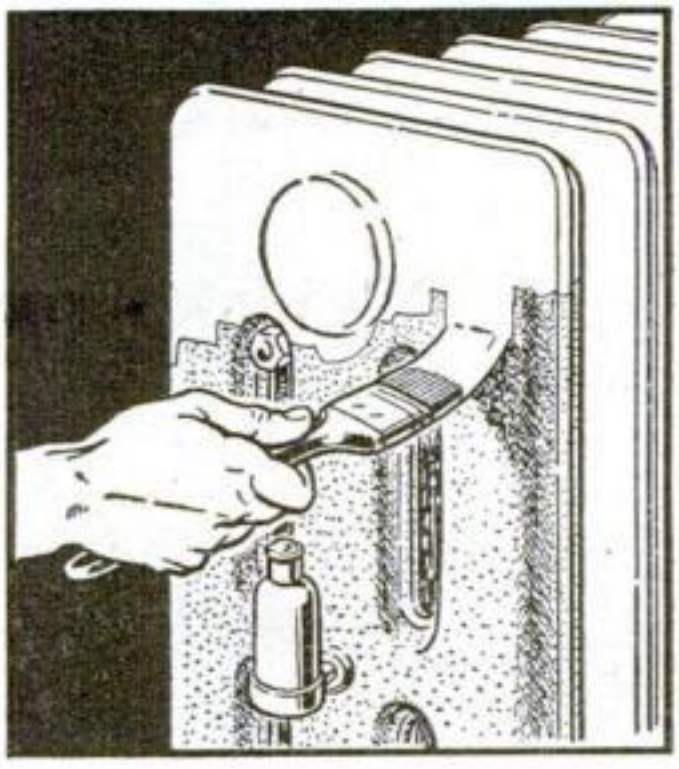
| No. Pc. | Description | T. | W. | L. |
|---|---|---|---|---|
| 4 | Legs | 2 | 3 | 24 |
| 4 | Rails | 2 | 3 | 18 |
| 1 | Stretcher | 2 | 3 | 31¼ |
| 2 | Side Aprons | 1 | 4 | 19½ |
| 1 | Front Apron | 1 | 4 | 36⅞ |
| 1 | Backboard | 1 | 8 | 36⅞ |
| | Top Planks | 2 | 19½* | 35⅝ |
| 1 | Hard Composition Board | ⅛ | 19½ | 35⅝ |

Miscellaneous: 28 No. 8 1¼" flathead wood screws, 34 No. 14 3½" flathead wood screws, 1 8-oz. bottle of glue.

Note: All dimensions above are given in inches for stock sizes. Finished sizes are shown on the drawing.

*Two or three planks may be used to give the total width of 19½".

## FINISHING RADIATORS AND PIPES [ PAINTING ]



1. Clean surface with sandpaper and steel scratch brush. Wipe with clean rags and denatured alcohol to remove all traces of oil and grease. Do not use gasoline.

2. Radiators, if new and unpainted, should receive a first coat of standard metal primer, which should be allowed to dry hard.

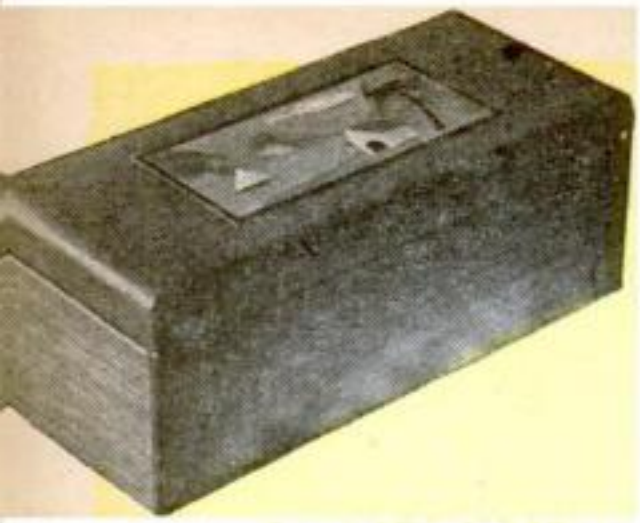
3. The finishing coats should be an eggshell or flat finish identical with the wall or woodwork of the room. This type of finish gives increased heat radiation. Avoid using bronzes, if possible, because they cause a definite loss in heating efficiency, particularly on radiators.

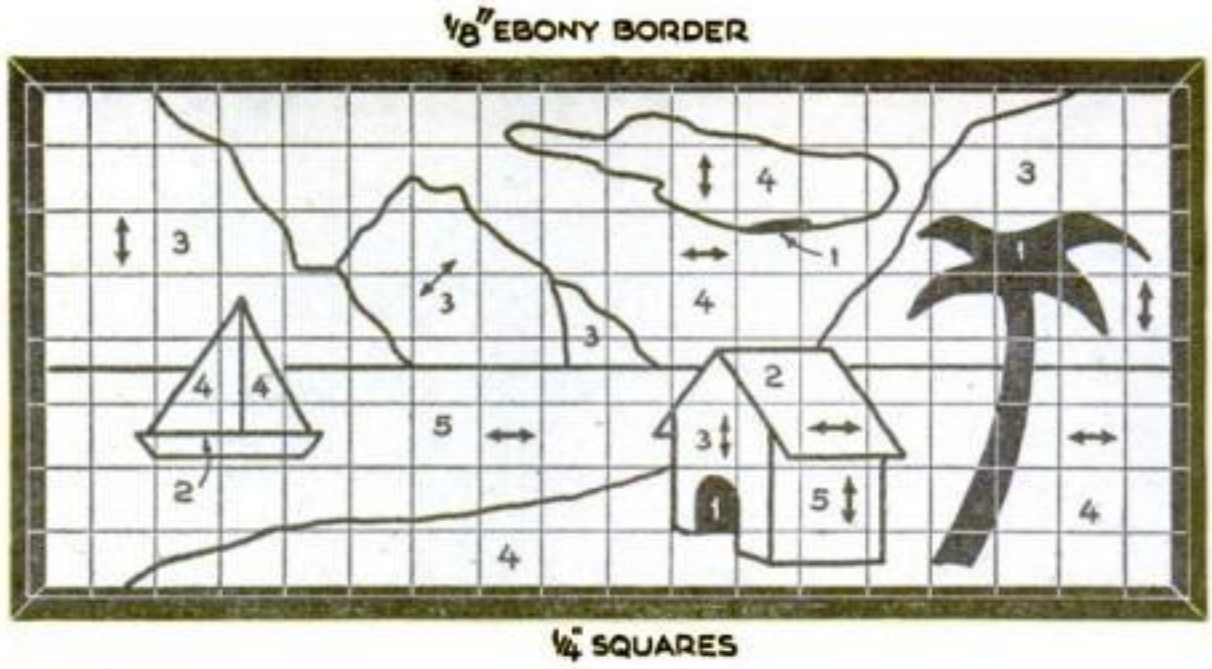
4. Allow all possible time for drying before the heat is turned on, and then bring the heat up slowly over a 12-hour period.

POPULAR SCIENCE MONTHLY SHOP DATA



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1-EBONY
2-TEAK
3-WALNUT GUNSTOCK
4-CIGAR-BOX WOOD
5-WHITE EBONY
⟷ DIRECTION OF GRAIN

## Tropical Scene Inlaid in Five Woods Decorates Jewelry Box

WHILE stationed in the Philippines, I decided to try my hand at a job of simple inlay. Here's what resulted—a tropical scene on the cover of a jewelry box that I made from a wood resembling mahogany.

In this five-wood inlay, I blended ebony, the white part of ebony wood, teak, walnut from a gunstock, and cigar-box wood, running the grain of each piece in the direction that would give the best separation from and contrast with adjoining pieces.

Sides, ends, and the bottom of the box were cut from 5/16" stock, the box standing 2⅜" high and being 3⅞" wide and 8⅜" long. The inner face of the ¾"-thick cover was hollowed to a depth of ⅛" with a lip of about ¼" around the edges. Heart-shaped hinges were cut from silver coins pounded flat, and a silver chain from an identification bracelet attached to the inside of one end of the box keeps the lid from falling back.—EMIL GAYNOR.

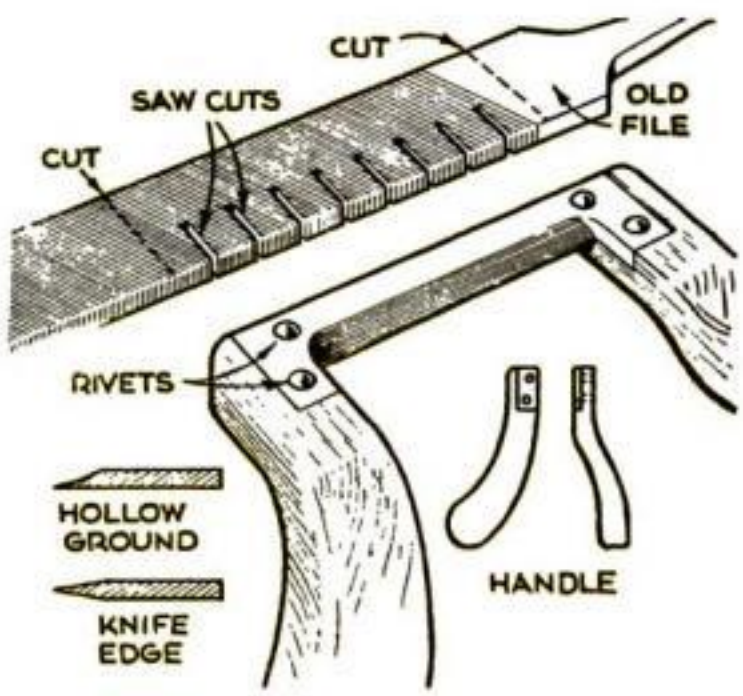


## Tweezers Bent from Scrap of Plastic

BECAUSE of its springiness, plastic is a good material from which to make a pair of tweezers. A scrap of ⅛" plastic an inch or so wide and 13" long will do for the job. Taper the width of the piece from ¾" at the center to ¼" at the ends, being careful to get the two halves identical. Bevel the ends with sandpaper. Heat the plastic in an oven to about 300 deg. F., remove it with gloved hands, and bend in the center so the ends meet squarely.—FRANK SHORE.

## Blade for Handy Midget Spokeshave Is Made from Old File

MODELMAKERS in need of a small spokeshave can make one from an old flat file. Heat the file red hot and allow it to cool slowly to soften the metal. Mark the length of the blade with a cold chisel, hacksaw parallel slots about 3/16" apart, and knock out the lugs. File or grind the steel to a hollow-ground or knife edge, saw off the excess metal at both ends, and drill holes for rivets. Harden the blade by heating it evenly until red and plunging into water; then temper by reheating until a spot on the edge previously polished with abrasive cloth turns a brownish purple. Immediately quench in a mixture of two parts of motor oil and three of linseed oil. Hone the blade and mount it on maple handles.—JOSEPH ROTH.

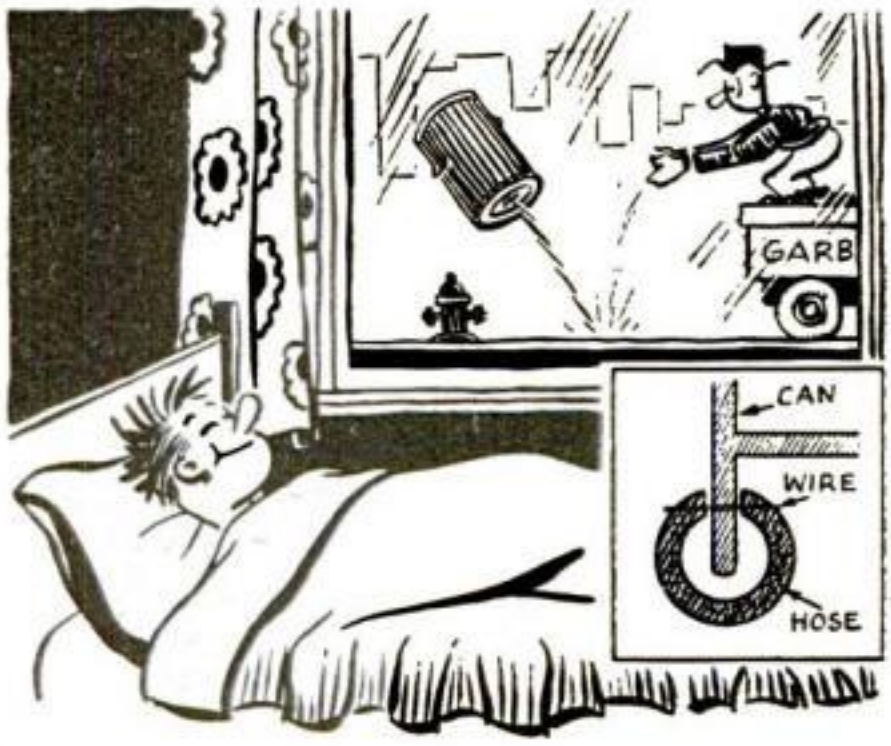





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# WHAT'S YOUR INGENUITY QUOTIENT?

*Have you pulled off a smart one lately? We will pay for each contribution accepted for this page showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.*



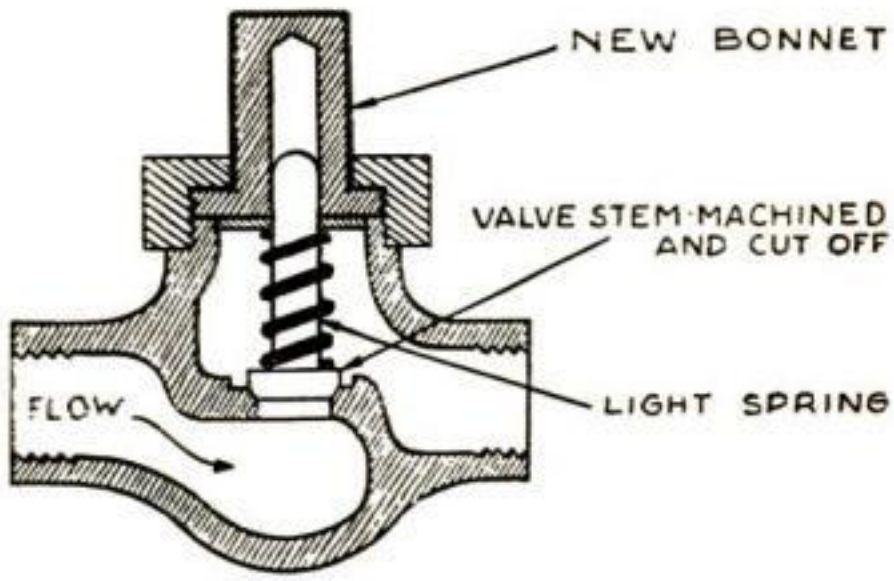

**GARBAGE GAITIES,** the hilarious game the collection crews play under my window at dawn, may be a lot of fun to them, but not to me.

During one of the noise-filled sessions, I dreamed up this idea of slitting a rubber hose and wire-lacing it to the bottom rim of a can. It has proved to be a bang-up as well as a clang-free success.—IRA MINOR.



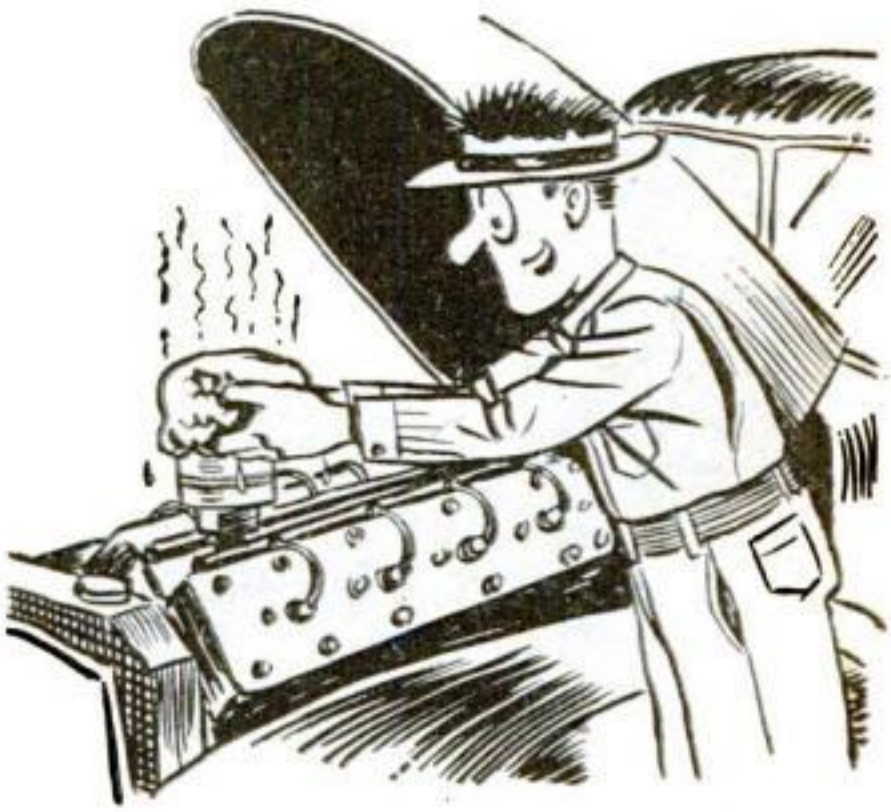

**WELL, BLOW ME DOWN!** The fans we salvaged from smashed vehicles in Burma turned out to be souvenirs instead of breeze machines. They needed 24 volts, and we had 115. A water-filled can gave me the makings of a water rheostat, but at first the fan didn't run. Those who smirked stayed to stare, though, for I flipped salted peanuts into the can, making the water conductive—and starting the fan.—J. J. STANKOSKY.

**IN HER BRAND-NEW BONNET,** this globe valve looked like the prettiest thing aboard our ship. When a check valve checked out, leaving us in a lurch, I shortened a globe-valve stem, machined off the threads, and also machined a new bonnet. The addition of a light spring permitted the valve to operate in a vertical as well as a horizontal position.—ROLAND D. CUSHMAN.




**KEEP THIS UNDER YOUR HAT,** but if you ever have to get a dead-storage car started, here's a trick I've used. First remove the air filter and wedge the choke open. Then cover the carburetor with the crown of an old felt hat and saturate the felt with about an ounce of gas.

When the starter is pressed, suction from the cylinders vaporizes the gas through the felt and starts the engine pronto. It runs long enough to fill the fuel line and start the pump delivering gas.—R. L. GOUDREAU.





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# Carved Card Tray

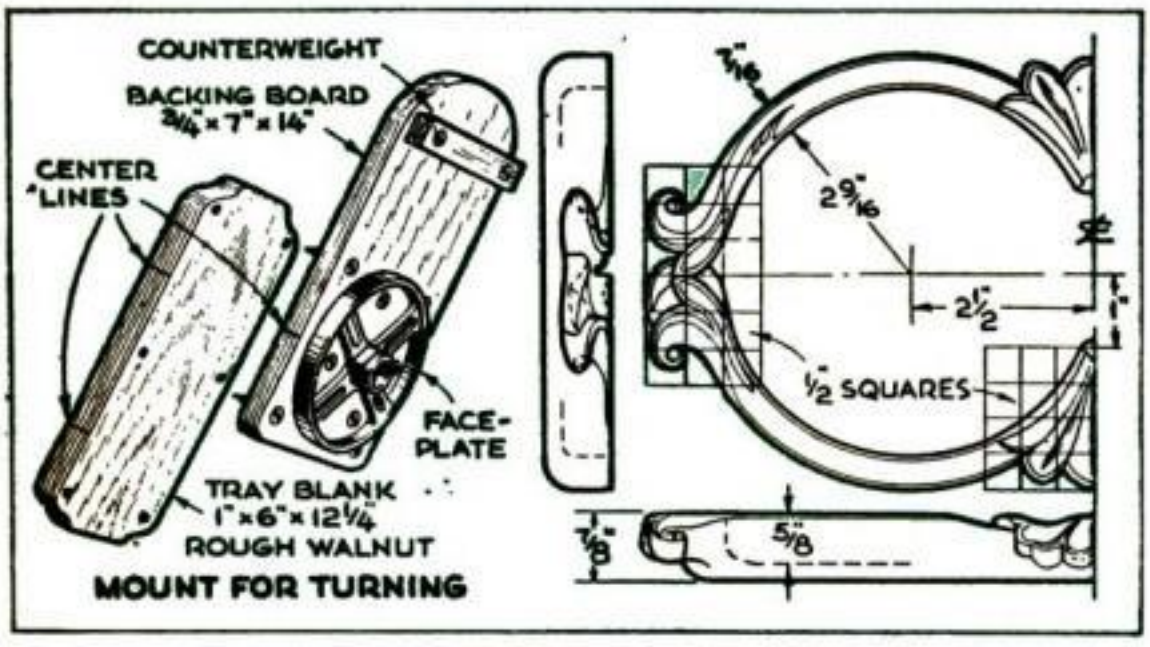
## IS HOLLOWED BY TURNING

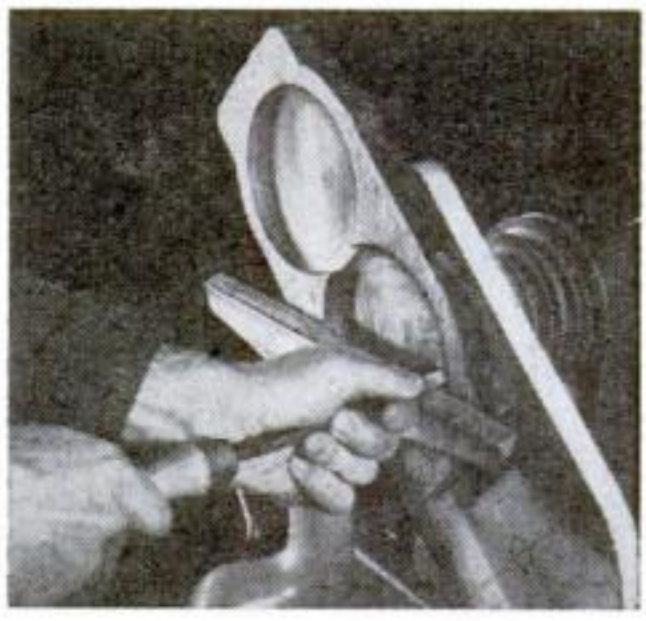
FOR THIS little card tray a gnarled and crossgrained scrap of rough 1" walnut or mahogany is just the right stock. Plane the piece to a ⅞" thickness, transfer the pattern outline, and cut it roughly oversize.

Pockets are turned by screwing the blank to a pine backing board mounted on the outboard end of the lathe spindle. The board acts as a counterweight to reduce vibration. Belt the lathe for slowest speed, tuck up your loose cuffs, and stand well back while turning. If there is still vibration, screw a cleat on the pine board to increase the counterbalancing effect, shifting its position until fairly smooth running is obtained. Reverse the tray on the backing to turn the second pocket, checking the contour with a cardboard template cut to match the first.

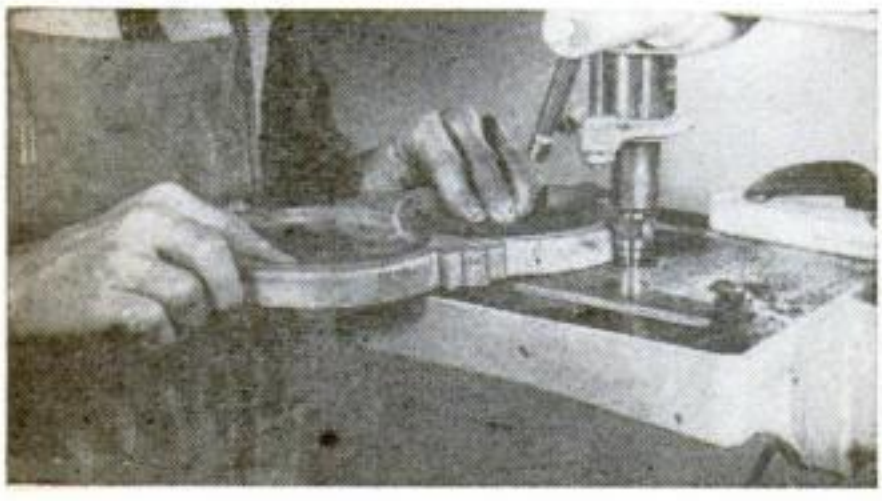
When the turning is finished, transfer the full pattern to the work and scroll-saw the edges. Smooth them and run against a small quarter-round shaper cutter. In doing the carving, outline with a veining gouge and then hollow the center leaves. Carve with long strokes, carrying out the effect of stem butts that branch around the pockets and terminate as overlapping leaves.

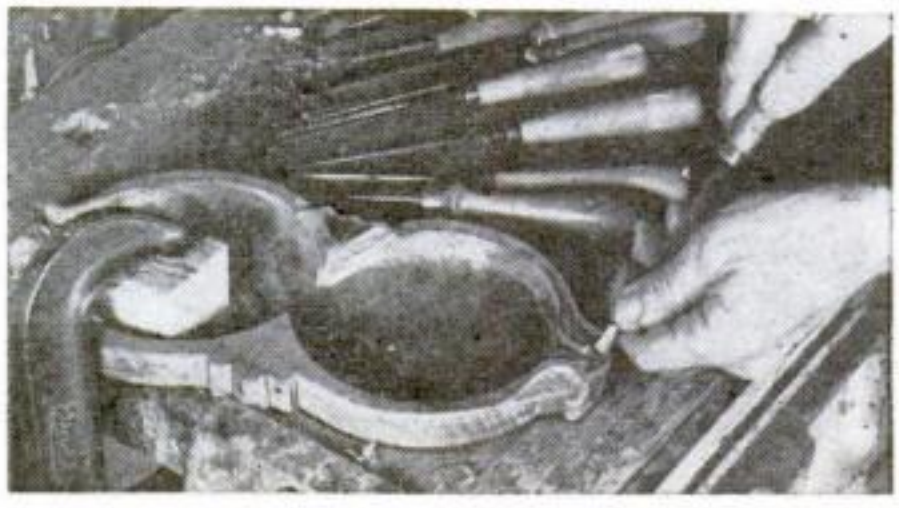
Sand only inside the pockets. Finish with two coats of shellac and one of wax. Then glue felt to the bottom.—EDWIN M. LOVE.



Pockets are formed on a lathe by mounting the tray blank on a projecting backing board that acts as a counterweight to reduce vibration. The edges are shaped with a quarter-round cutter. Leaves are carved.







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# A Sturdy Bandsaw Base

By C. W. WOODSON

FOR the average home shop, a small bandsaw is most convenient to use and gives best results when it is mounted on a substantial individual base. Having its own stand and motor permits the saw to be moved about the shop as occasion demands freeing it from the space limitations of a permanent place on the bench.

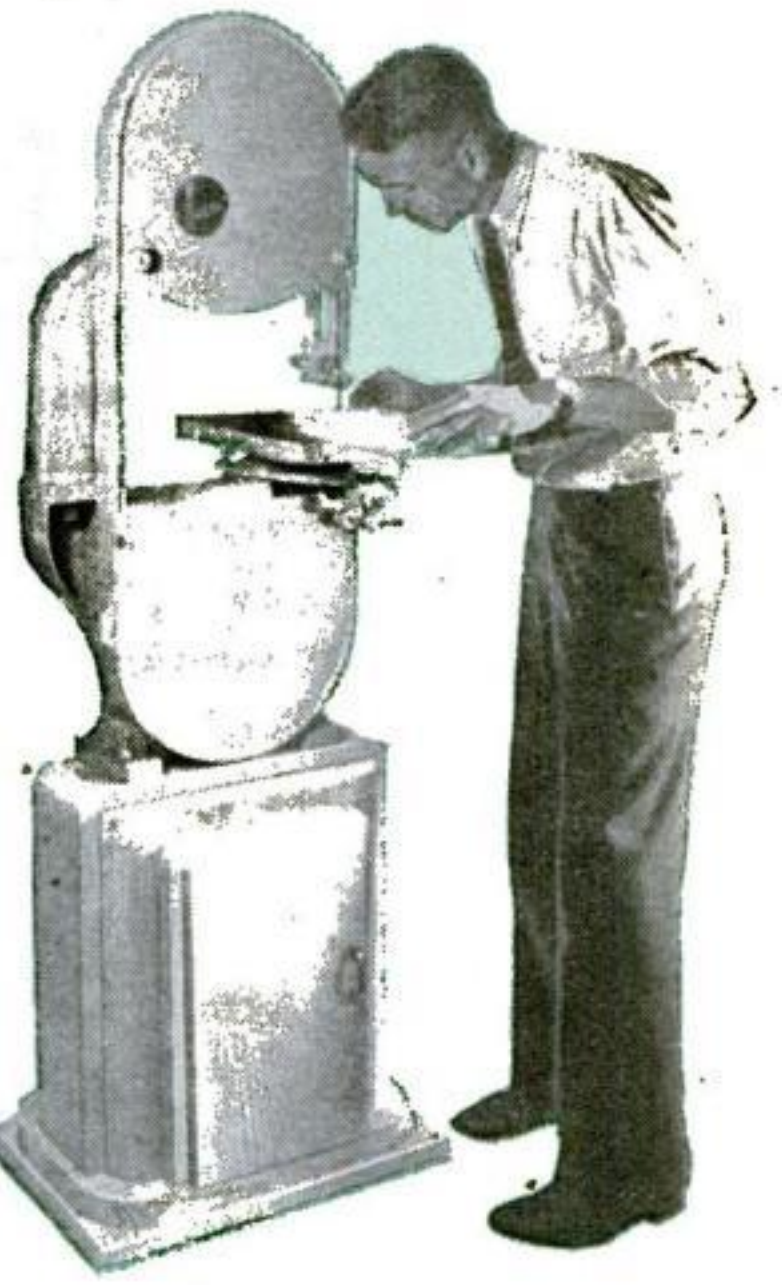
Soundly designed to be built of heavy stock, the base illustrated here will furnish solid support for the saw as well as housing for the motor. The legs are made of wood 3½" square, rounded on one corner, and mortised for side and end rails. Waste two-by-four stock is used for the rails.

All frame parts, with mortises and tenons cut, are shown in the dimensioned photograph at the lower left. In the center view the top and base have been added to the assembled frame, and a ⅞" by 11" by 17" shelf has been notched in place to support the motor.

Rounded-corner baseboards are fastened to the frame with glue and long screws that run into the bottom of the cross rails; screws are not driven into the end grain of the legs.

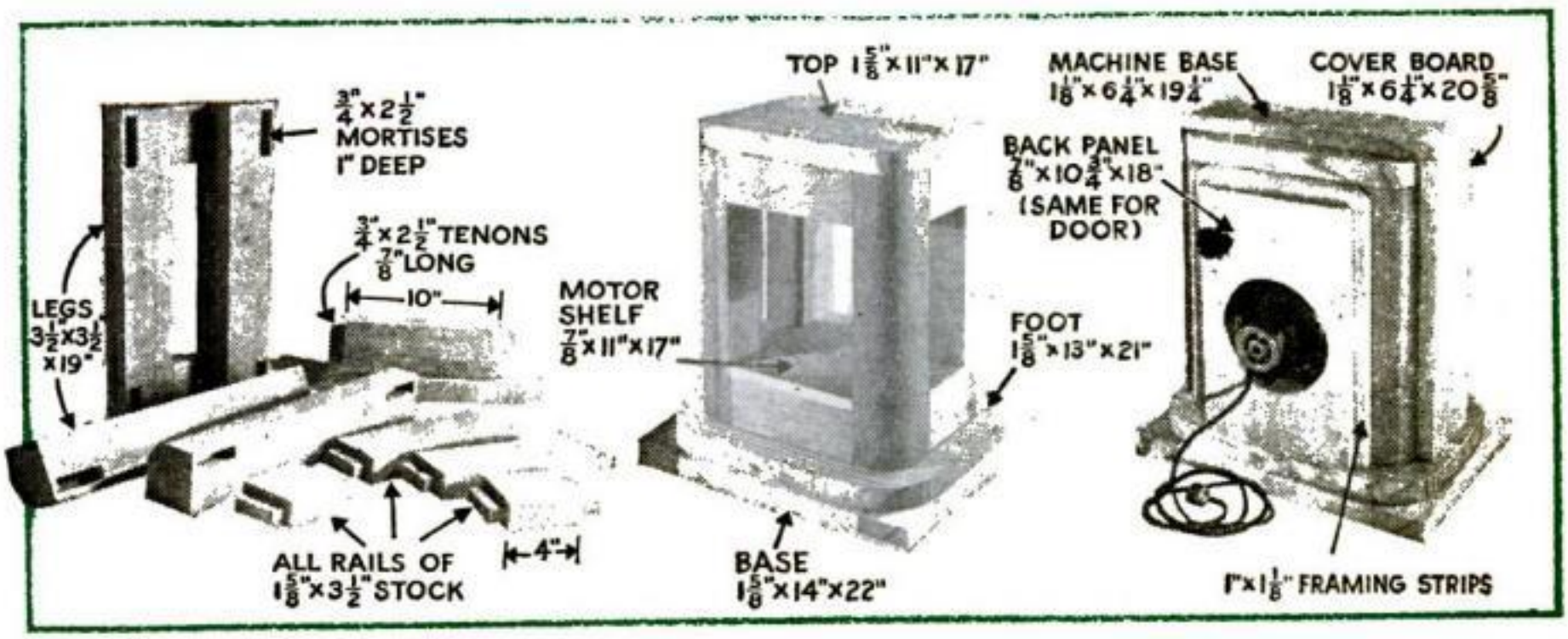
Front and back openings are built out with 1⅛" framing strips to increase the space allowed for the motor. A panel with a large circular hole is used to cover the back, as shown in the picture at the lower right. Screw fastenings make it possible to remove the panel easily when it is necessary to get at the motor. The front is closed by a hinged door as shown in the photo at the upper right.

Cover boards on both sides complete the



enclosure and add to the attractiveness as well as the strength of the design. Bolt the bandsaw in place on top of the machine base.

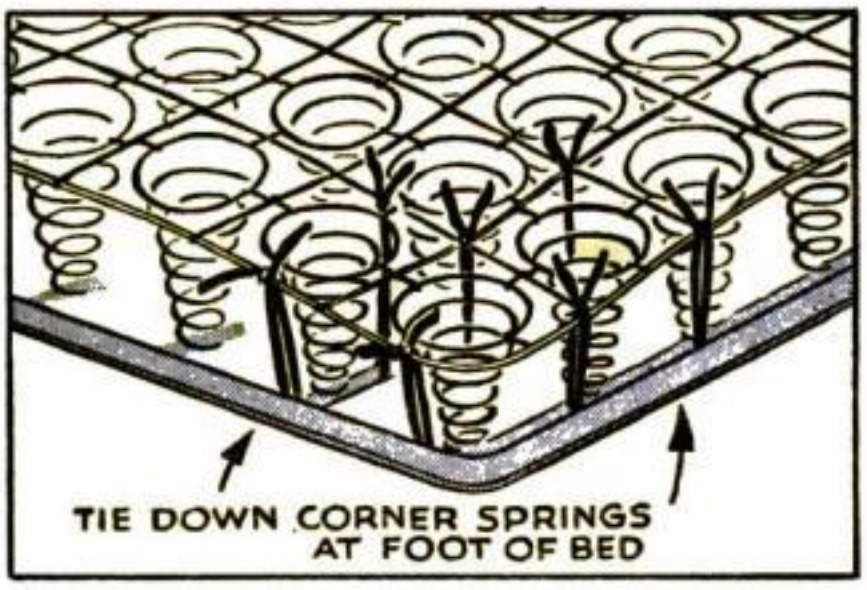
For metal cutting, a speed-reduction jackshaft could be bolted in an inverted position under the top of the cabinet.






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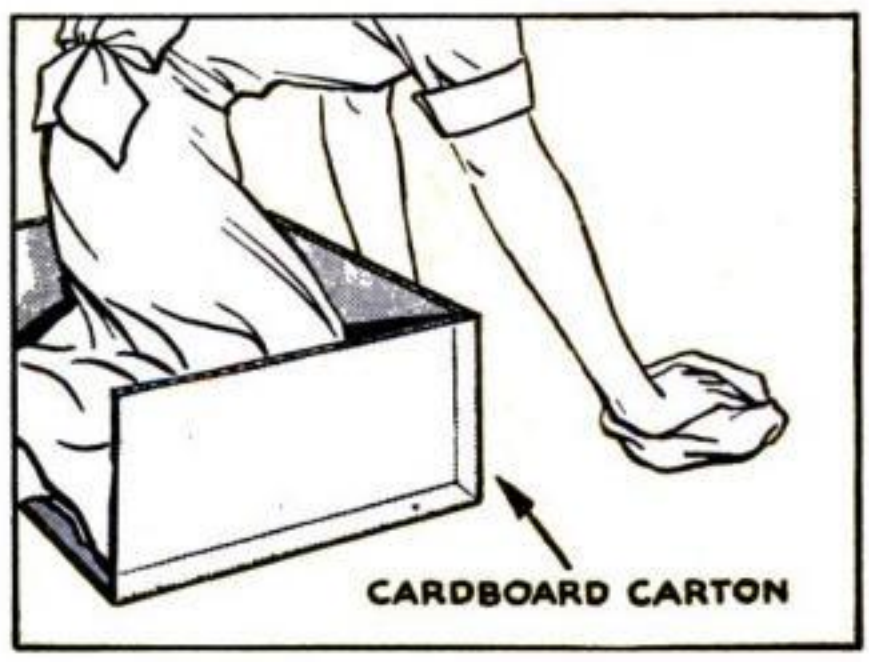
# KEEPING




Unsightly humps often occur when bed clothes are tucked under at the bottom corners. Tying down two or three springs at such corners so they are slightly compressed will lessen this annoyance.

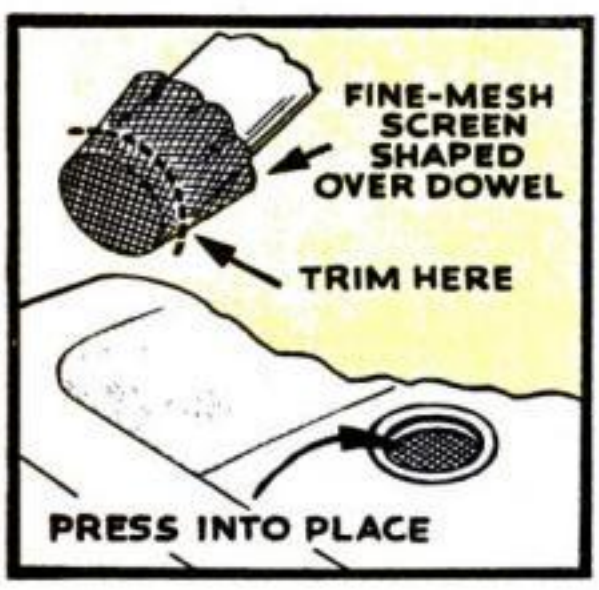



Paint rollers provide an economical and easy method of applying liquid wax to linoleum. Drill a hole in a broom handle for the roller arm and the waxing job can be done from a standing position, as shown.

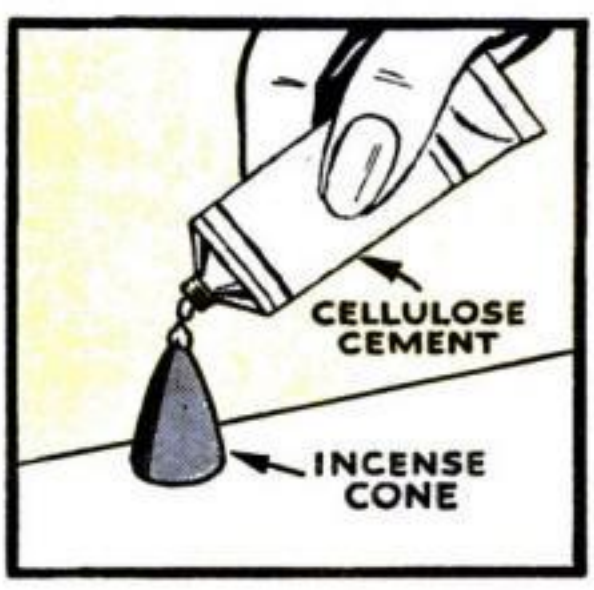



Cut one side of a cardboard carton at the corners, bend this side flat against the bottom, and you have a kneeling pad for use in scrubbing or mopping floors. The ends and side protect clothes.

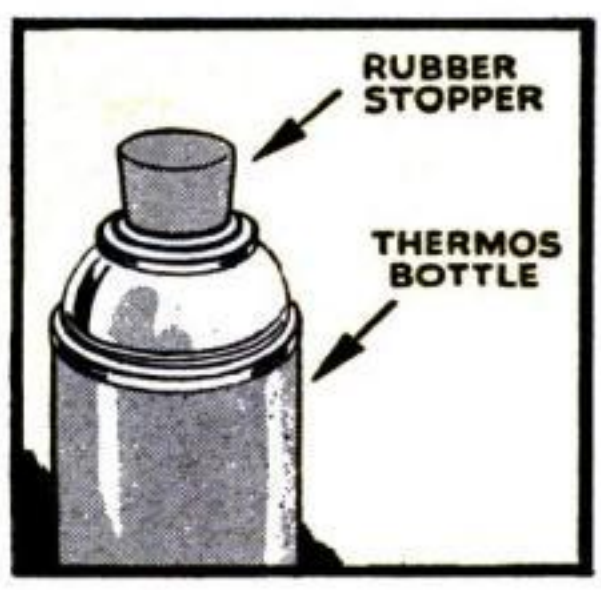
Fine-mesh screen, shaped and cut as below, makes a good strainer for a lavatory drain. Use a dowel 1/8" less than the hole diameter. Press down so the stopper will have clearance.




Cones of perfume incense ignite as soon as a match is touched to them if the tips are coated with a drop of cellulose cement. This dries and forms an inflammable coat that ignites the incense.



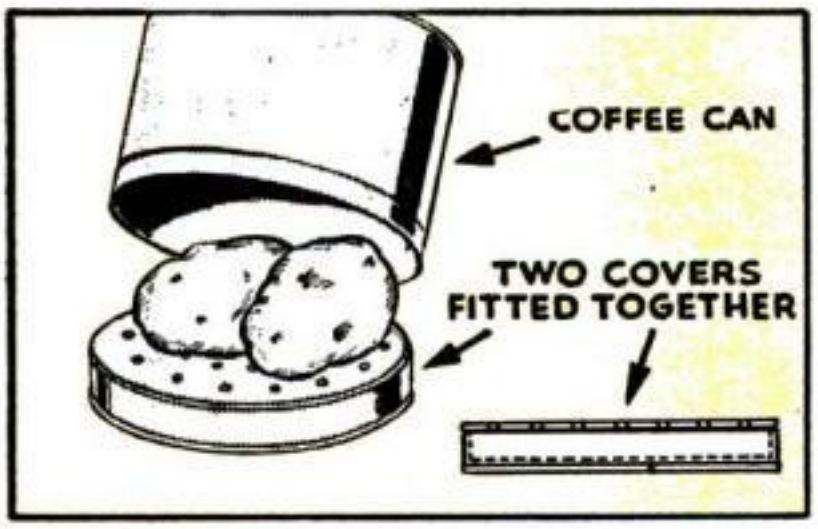

Milk often soaks into tiny cracks in the cork of a thermos bottle. Because this milk is difficult to remove, it spoils, causing an offensive odor. This annoyance can be ended with a rubber stopper.



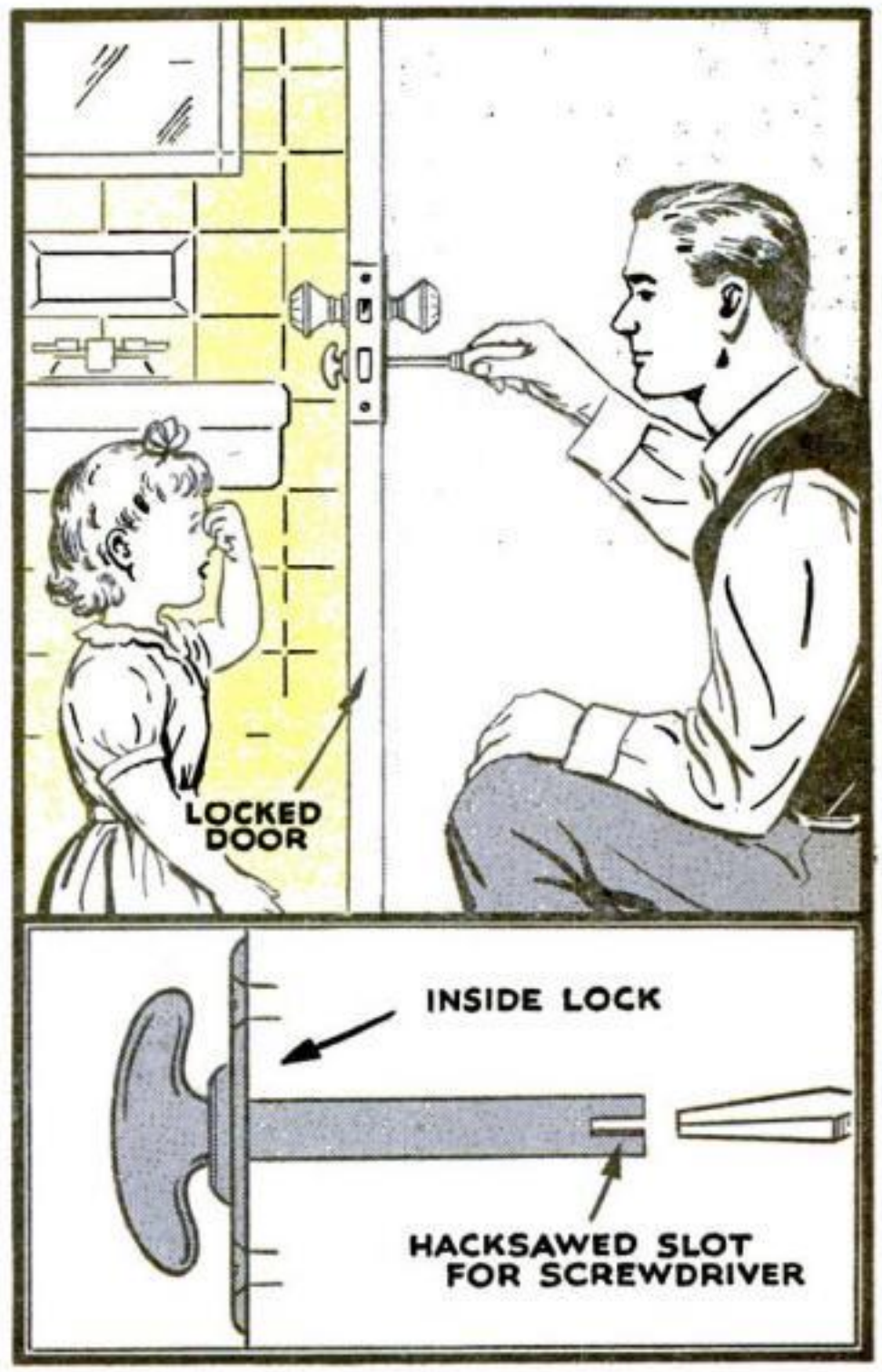



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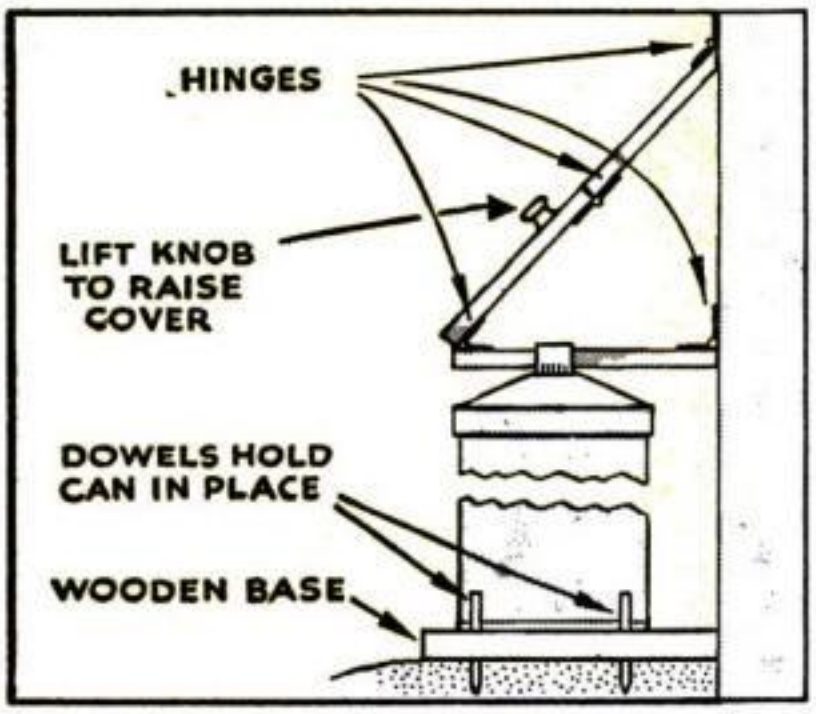
# THE HOME SHIPSHAPE




You can make this stove-top baker and hot-plate from a coffee can and two lids. Try to find a lid that will fit snugly inside the can lid. Then punch holes in this one, which faces up.

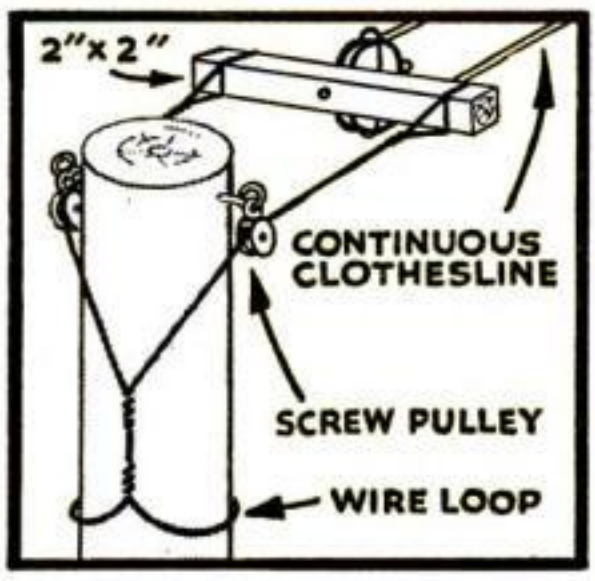



Newspapers frequently tell of firemen climbing through bathroom windows to reach children locked inside. If your bath has the type of inside lock shown here, it can be altered as indicated for opening from outside.




Dogs cannot upset this garbage can or nose off its cover. In addition, the cover automatically returns to place when released. Heavy dowels or pipes serve to locate the can on its base.

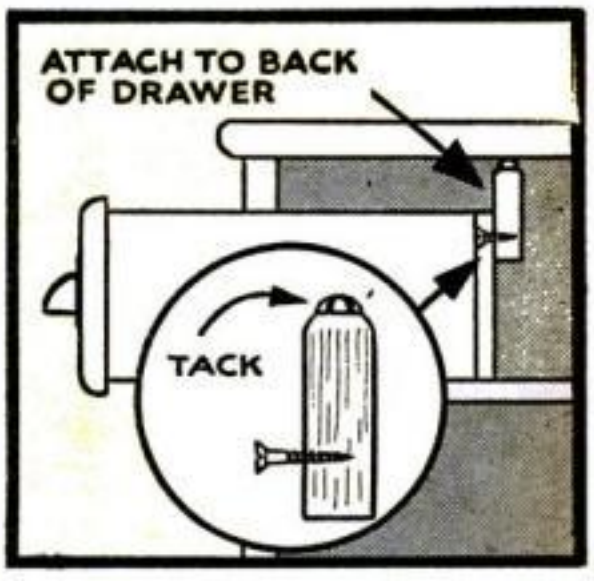
Wire loops around a post have a powerful snubbing effect. Put to use as indicated, this makes it possible to tighten a clothesline with one downward pull. The idea also is usable on a plain line.




Transparent windows of billfolds often become frosty-looking after long use. Jeweler's rouge applied to the surface and polished with a soft cloth will bring back the original transparent appearance.




Small wooden blocks attached as illustrated below will prevent the drawers of kitchen cabinets from sagging when pulled out. A smooth-headed tack on the tip of the block makes it slide easily.






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# Topsy-Turvy TURTLE SUN DIAL



By JOHN A. McKINVEN

RECLINING in a garden clearing, or near a rocky pond, Mr. Turtle obligingly lets the hours sweep across him while his tail casts a shadow that tells you the time.

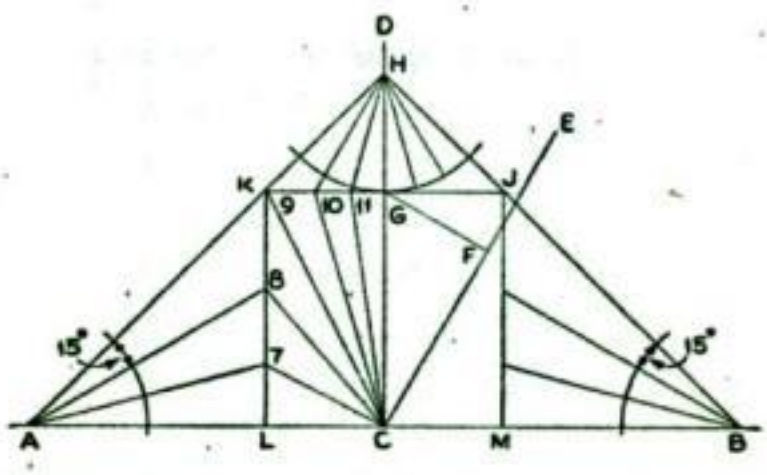
His body is built of three pieces of ¾" stock, shaped in the form of two equal circles with centers 1" apart. With the largest one on top, the radius of each succeeding lamination is reduced ½". The layers are fastened together with nails and waterproof glue.

Any nonrusting metal can be used for the dial—aluminum, lead, brass, dural, copper, and so on. It is laid out in the same manner as the body but with 3" radiuses, and the feet added to the outline. Hour lines are scribed on the metal from a paper pattern plotted for your latitude.

The turtle's tail acts as the index or gnomon of this sun dial; it is cut from metal at least ⅛" thick, and mounted on the base with wood screws. To cast a proper shadow, it must have an angle equal to your latitude, which you can determine from a good map

## How to Lay Out Hour Lines

1. Draw the line **AB** and erect a perpendicular **CD.**
2. At **C,** draw **CE** so that the angle **DCE** equals your latitude.
3. Anywhere along **CE,** draw perpendicular **FG.**
4. Measure **GH** equal to **FG.**
5. Make **CB** and **CA** equal to **CH** and draw **AH** and **HB.**
6. At **G,** draw **KJ** perpendicular to **CD.**
7. Drop **KL** and **JM** perpendicular to **AB.**
8. At **H, A,** and **B,** draw arcs with radius **HG.**
9. Divide these arcs into 15-deg. segments, and extend radiuses until they intersect the sides of the square **KJML.**
10. The lines drawn from **C** to these intersections are the hour lines for your latitude. Thus, **CG** is the 12-o'clock line, **LC** is 6 A.M.; **CM** is 6 P.M.; **CK** is 9 A.M. Afternoon hours are omitted from the diagram for clarity.
11. On the turtle sun dial, trace these lines with **C** at the rear edge of the dial, and the 12-o'clock line coinciding with the center line of the turtle. Leave room at the edge for numbering the hours. The 6-o'clock line need not be included.




## DIVE-BOMBER

THE crowing cock and the simple arrow have been telling the direction of the wind for so many years that they have fallen behind the times; on a modern home, they seem a little out of place. But weather vanes can be as timely as a flight of planes, as witness the photo at the right.

This formation of dive bombers is made of sheet metal. Enlarge the pattern and trace it onto the metal. Cut at least the three leading planes out of one piece for greatest strength, using inside and outside tin snips. Where it is necessary to join two pieces, use a soldered patch.

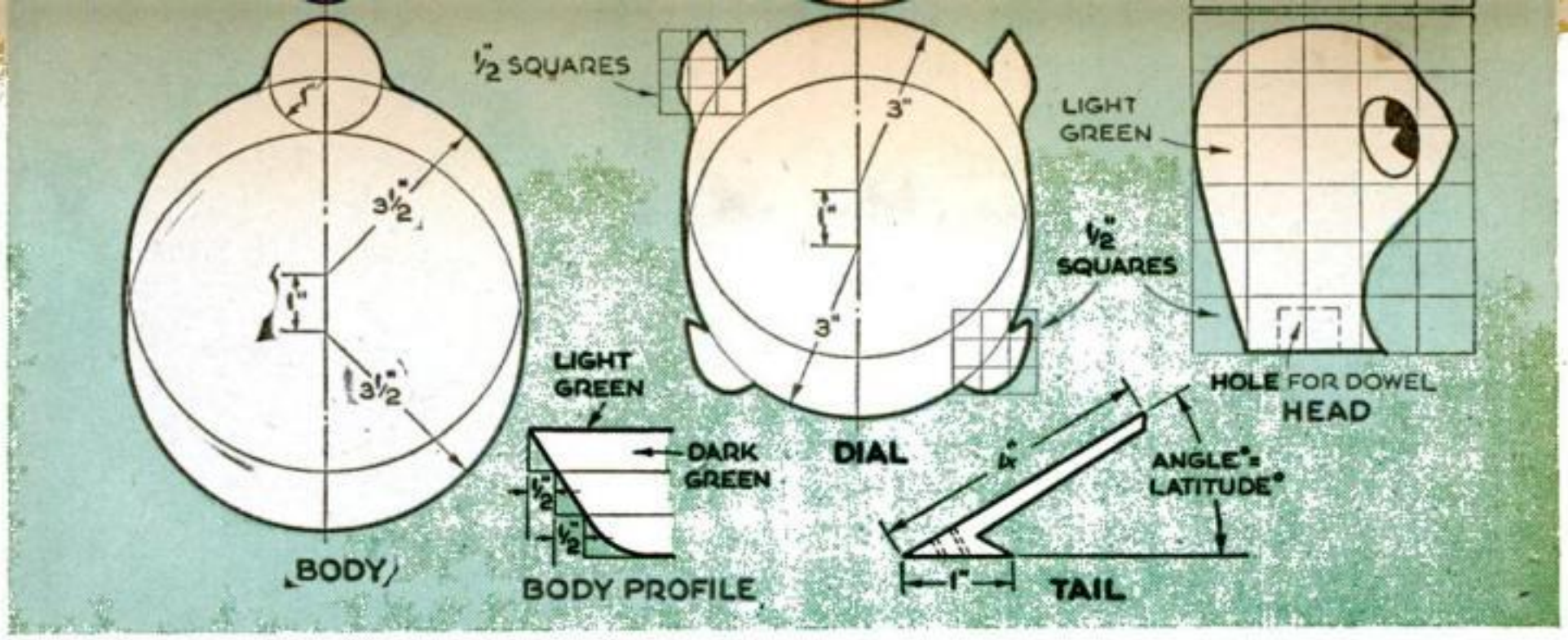
To make the slots that represent the wings, drill a hole at either end and chisel out the remaining stock, using the end of a hardwood block as an anvil.

The two points where the planes meet in head-to-tail formation are joined by means of split rivets as shown in detail *A*. Drive a screw into the upper end of the brass-tube bearing to keep out rain.

It is necessary to add a counterweight to the fuselage of the leading plane in order to obtain a free-swinging balance. Determine the necessary weight by trial. A coat of black outdoor enamel finishes the silhouette.—GEORGE E. HARRINGTON.



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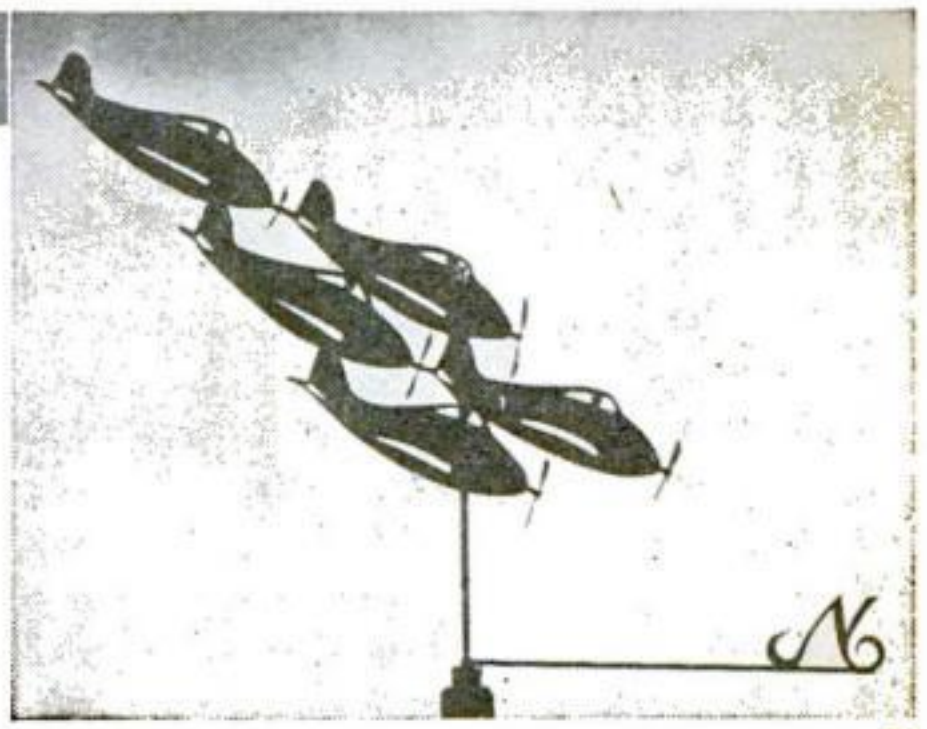

or from the office of any local surveyor.

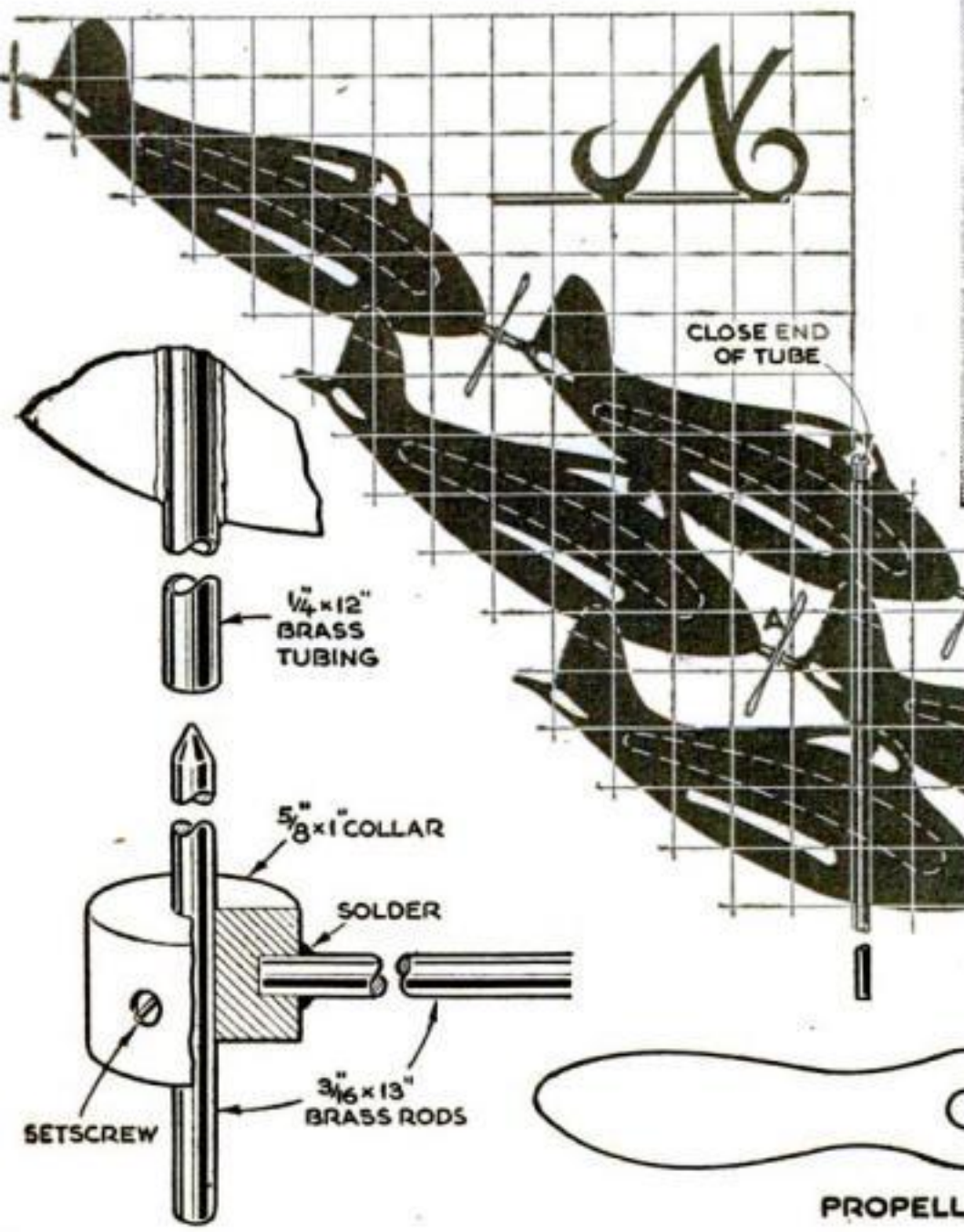
Make the head of ¾" wood or thicker, and attach it to the body with a dowel. When the dial is inscribed, center it on the body and fasten it with four roundhead brass screws. The tail is attached at the vertex of the hour lines; it must be perfectly vertical and parallel to the 12-o'clock line.

Two precautions are necessary when setting the finished sun dial in place. The dial plate must be level; adjust it with a good carpenter's level. Also, the 12-o'clock line must coincide with the true north-south line. When properly aligned, the gnomon points to the North Star.

The time registered by any sun dial is local apparent time, and may run as much as 16 minutes ahead or behind your watch during a year. In addition, the dial will be one hour ahead of daylight-saving time.

# WEATHER VANE

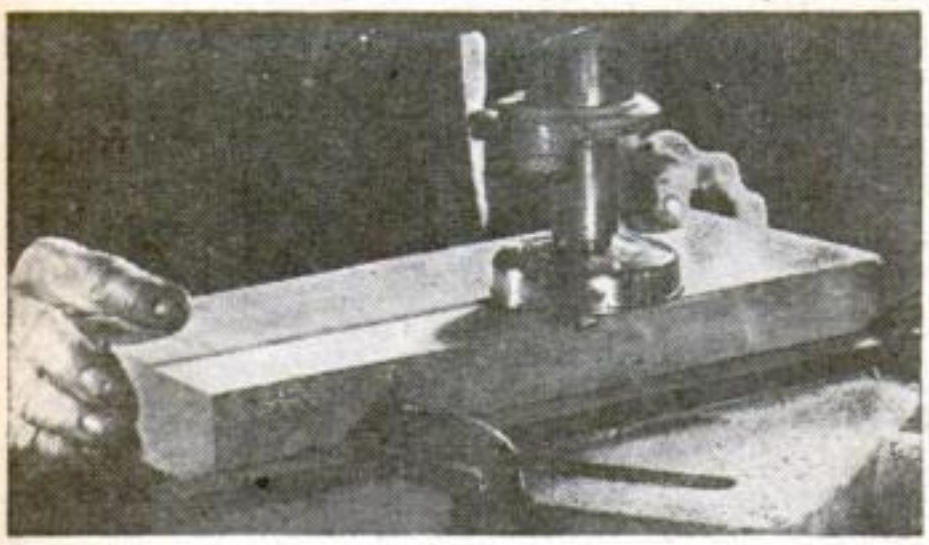




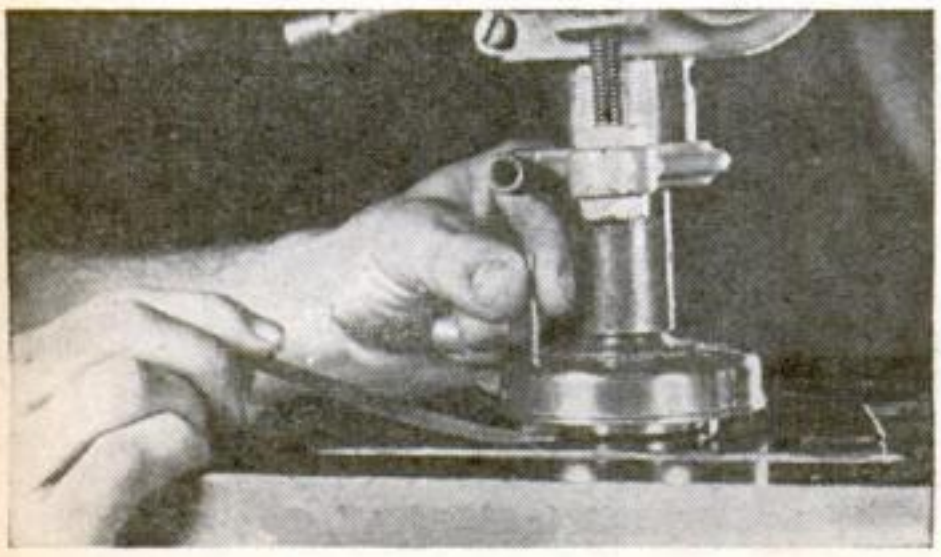


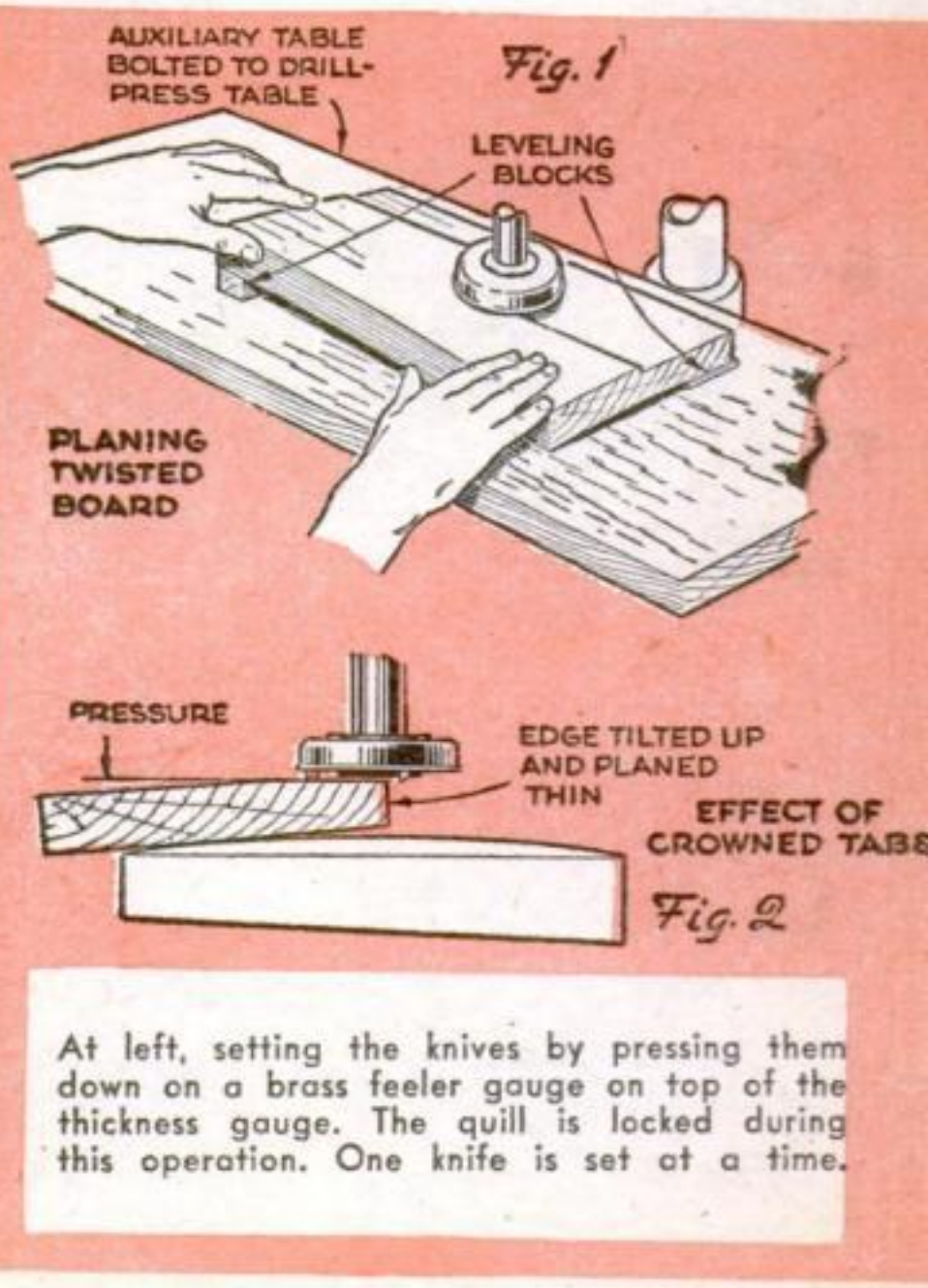

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Raising a panel with curved sides. A fence cut to the same curve guides the work. For a curved raised edge on a straight-sided panel, use the same setup after tacking a curved guide to the edge of the work.



For planing, a fence is clamped diagonally across the table and is swiveled back for each new cut. When the center of the board is reached, the work is turned end for end for planing the other half.






At left, setting the knives by pressing them down on a brass feeler gauge on top of the thickness gauge. The quill is locked during this operation. One knife is set at a time.



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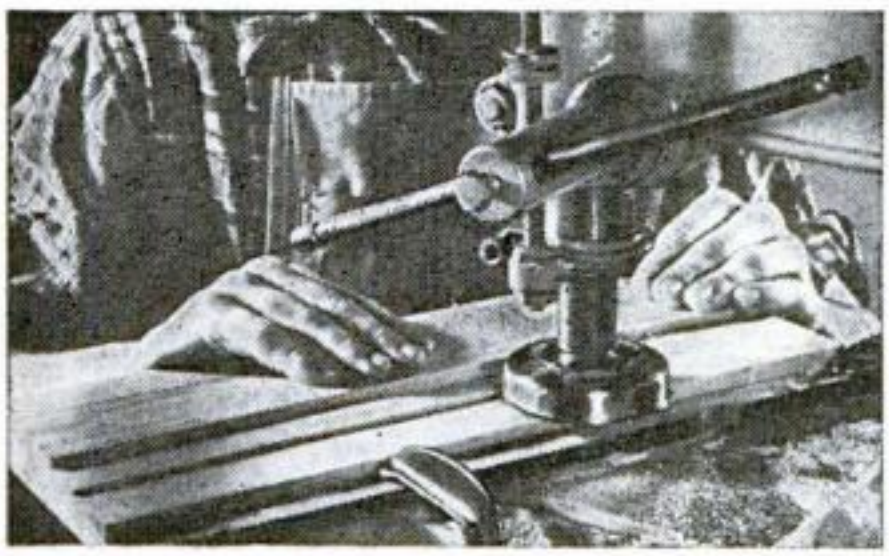
# The Drill Press as a Planer

By EDWIN M. LOVE

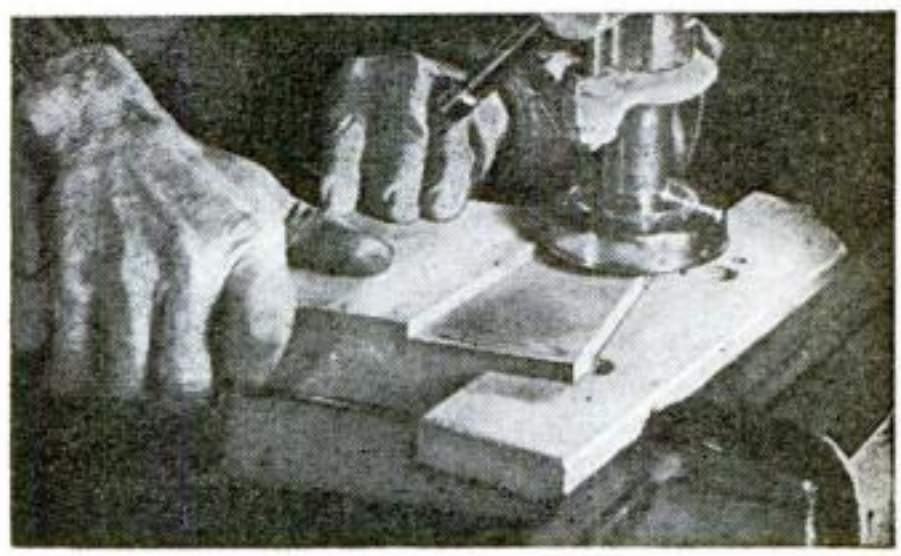
HOME craftsmen who have a drill press will find a rotary planer offers a speedy, accurate method of surfacing wide boards. The attachment is inserted in some drill-press chucks in the same way as an ordinary drill or router bit. Special adapters are available for use with taper-shank chucks.

The tool can be used on boards up to 12" or 14" wide. Stock being surfaced passes between the cutters and the table and is straightened and brought to uniform thickness. Not only does the planer eliminate the need for hand tools in surfacing, but it also can be used for rabbeting and its variations, panel raising, tenoning, and wide grooving and routing.

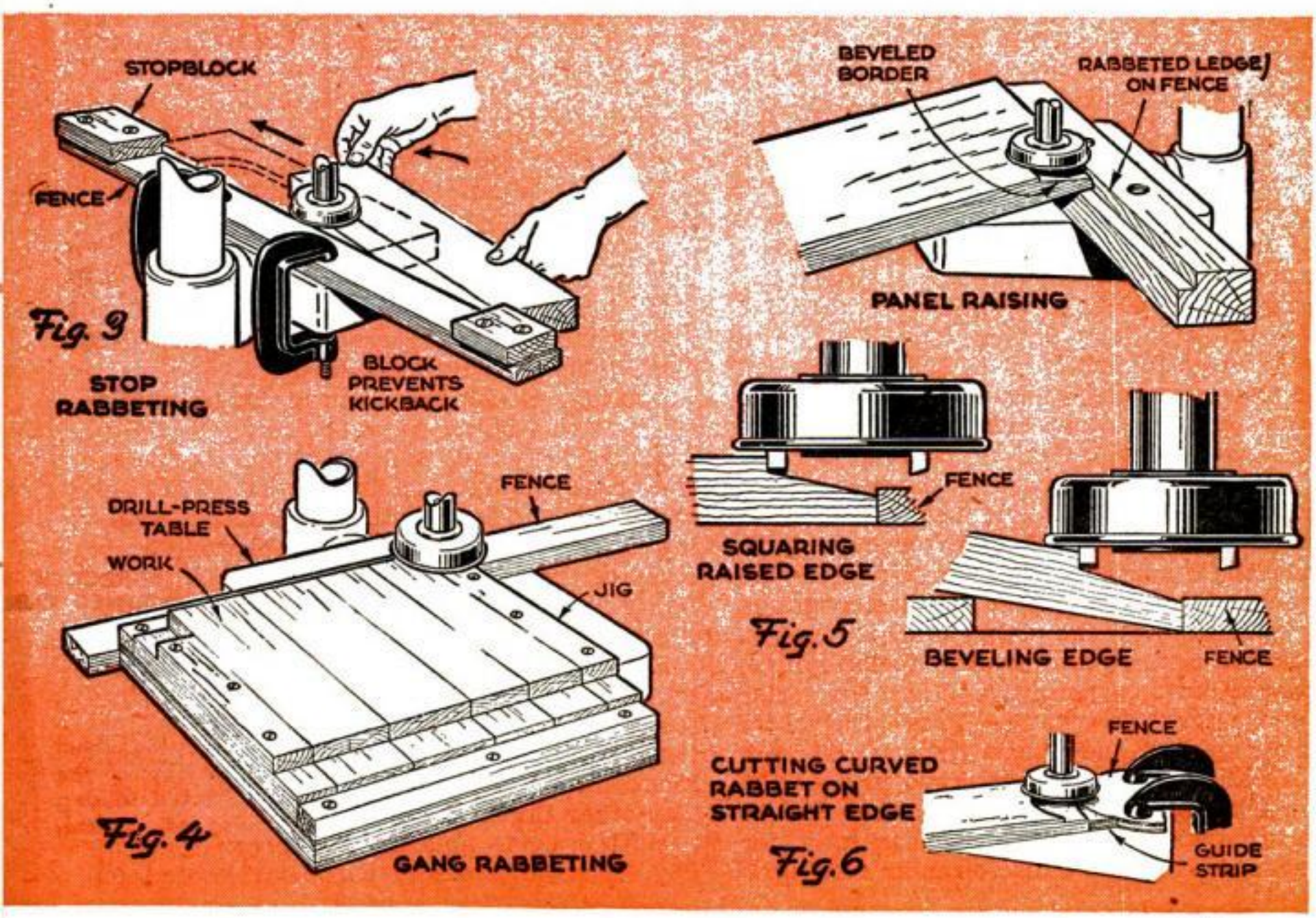
Set the drill-press table level and clamp a wood fence ¼" thick on it diagonally from the far left corner to near the front right. Belt the machine for its highest speed (up to 5,000 r.p.m.) and lower the planer to take the required cut. Rest the



Rabbeting is like taking the first cut in planing. In double rabbeting, make the wider rabbet first.

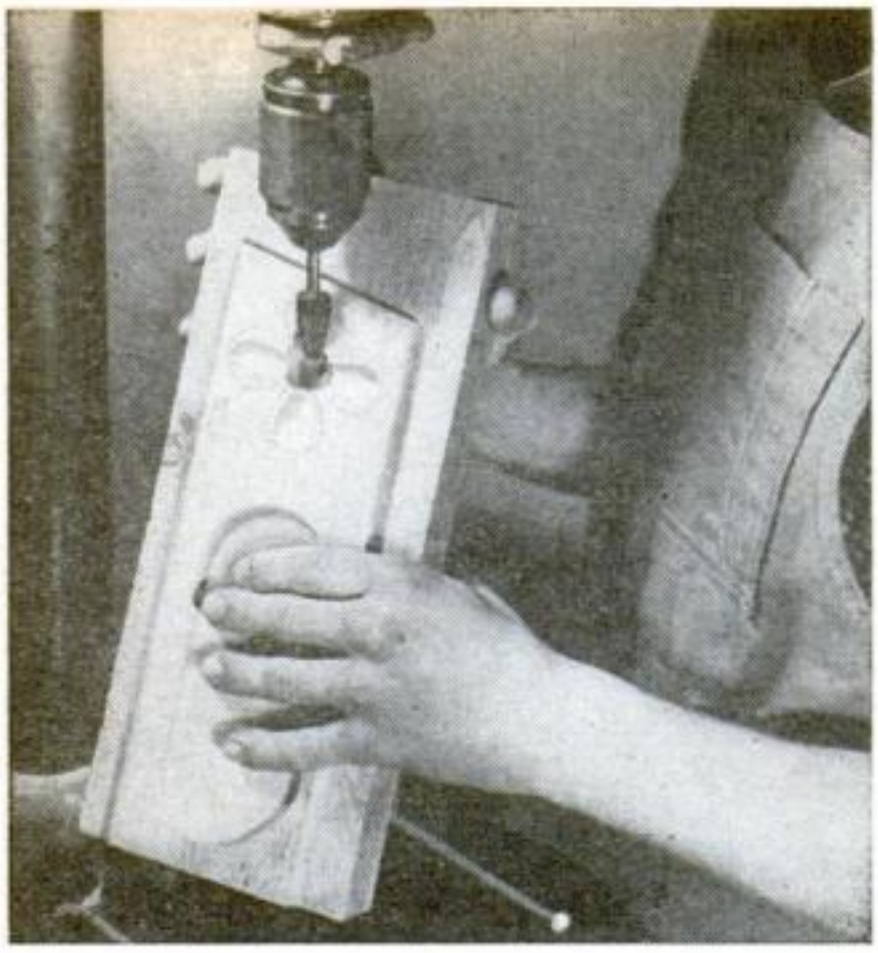


Taper rabbeting in a notched guide. Turn over the guide and work to cut the other side of a tenon.

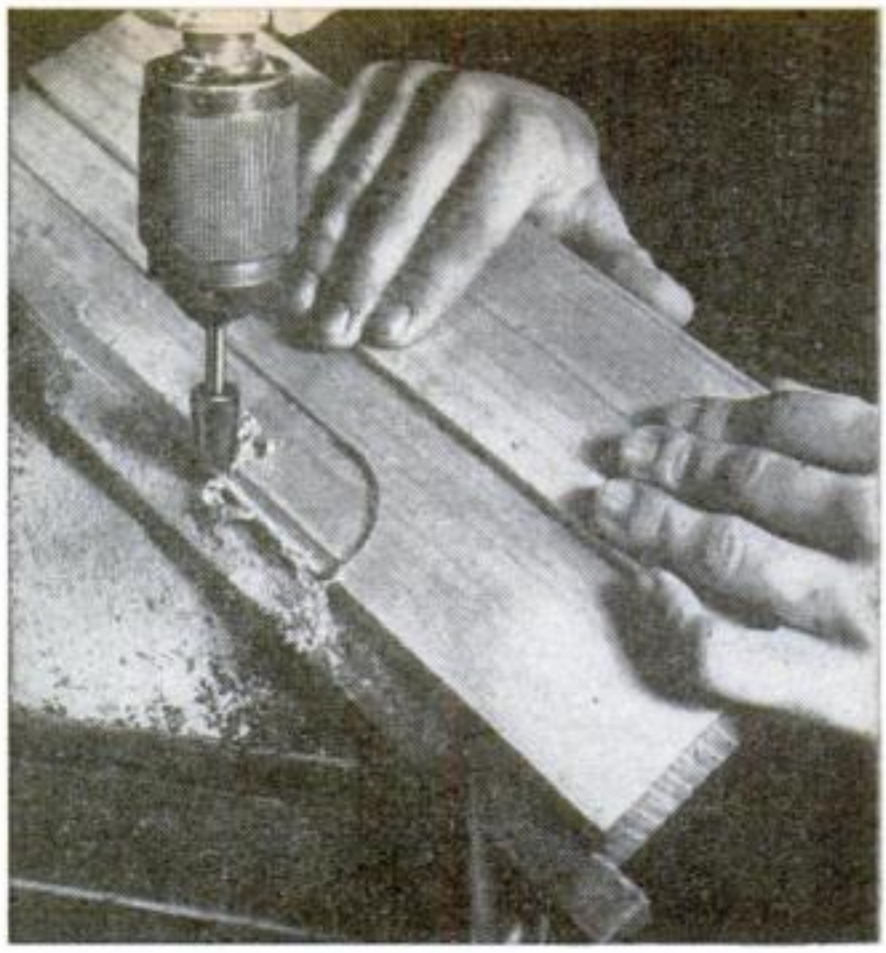





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Rotary files used in a drill press speed carving operations. Most such work is best done freehand with the piece held firmly and fed in lightly so the tool won't grab and pull it toward the chuck.



Working a cove with a rotary file. In this case, different parts of the file are brought to bear by tilting the table. The profile of the cut is further varied by changing the angle of the fence.

board on the table, press the edge against the fence, feed from the left with the left hand, and hold the board down with the right. Don't rock or lift the work, or it will be gouged. Take care, too, to keep the fingers away from the whirling cutters.

When one pass has been made, loosen the right end of the fence, swing it back, clamp it, and take another cut. This is continued to the middle of the board; then the piece is turned around and the process repeated.

Obviously the board will not be planed true unless the underside is flat. It is well, therefore, to plane the sides alternately so truly flat surfaces will slide on the table.

A board in wind (twisted) may be set up on blocks tacked under one or more high corners, as in Fig. 1, to make four contacts with an auxiliary table. Then the high points are trimmed off with the planer until one side is smooth, after which the board is turned and the other side planed. A fence can be used, but freehand planing is easy.

In setting the knives for planing, use a strip of brass or other soft metal for a feeler gauge, filing off the burr after cutting it. Place the thickness gauge provided with the planer on the table, rest the feeler gauge on top, and lower the planer until it touches. Lock the quill, withdraw the feeler gauge, loosen a cutter setscrew, and slip the feeler gauge under one knife. Press the knife gently against the gauge with a pin from above and tighten the setscrew. Rotate the planer backward and set the other knives the same way. Do the setting carefully, for uneven setting will cause circular scoring.

If the table is high on one side, there will be semicircular scoring on the high side. This can often be remedied by loosening the clamping bolt slightly, withdrawing the positioning pin a little, and striking the high edge with the hand. Tighten the nut and test again on waste wood.

Thin edges on planed boards indicate the center of the drill-press table is crowned (Fig. 2). Slight crown can be ground down with emery cloth on a block. A less permanent cure is to apply a coat of paint and sand off the center when it has dried.

Burning is caused by dull cutters. It can also be caused by feeding too slowly.

Rabbeting is similar to taking the first cut in planing, except that the fence is carefully placed for gauging the width of the rabbet and the planer is set to required depth. Special long cutters are available for deep rabbeting. Check the accuracy of the setup by rabbeting on waste wood first.

Taper rabbeting is done with the edge of the board set into a notched strip, which is slid along the fence with the work. Tenoning is simply a process of rabbeting both sides of the end of a rail. If tenons are to be off center, cut one side of all pieces, reset the planer, and rabbet the other sides.

Stop rabbeting is handled as on a shaper by screwing or clamping two blocks to the fence, as shown in Fig. 3. One block locates the starting end of the rabbet and prevents kickback as the work is fed into the blades. The other limits the length.

With a jig to hold them in position, as in Fig. 4, several pieces can be rabbeted or



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Hole cutters for use in a drill-press chuck are similar to an expansive bit. They are adjustable to any size hole, as indicated in the drawing below, and they will bore cleanly into the wood.



Besides boring wood, a hole cutter is useful also on plastic and thin metal, working these with the same rapidity and cleanness. When metal is being cut, the drill press should be run at low speed.

tenoned in one pass. When one end of the gang has been rabbeted, turn the jig end for end and rabbet the other end.

Panels are raised by rabbeting all around, cutting the ends first or starting with an end and continuing around the piece. For a beveled border, lift the edge on a rabbeted fence (Fig. 5). To square the inclined edge of the raised section, lay the panel flat and trim with the cutters; to incline it backwards, clamp a strip under the opposite end. Curved raised edges on straight-edged panels can be made, as in Fig. 6, with a fence cut to the desired curve, but convex for concave edges and concave for those that are convex.

Rotary sanders for use in the drill press work much like the planer. A small amount of stock is left on in planing and is then removed by the sander.

Rotary files resembling oversize dental burrs (Fig. 8) are useful drill-press tools for carving and odd shaping operations. When they are used freehand for carving, the work must be held firmly so the spiral teeth won't screw it toward the chuck, and it must be fed lightly into the tool. Various portions of the file are brought to bear by tilting the drill-press table when shaping, and the profile is further varied by inclining the fence on the tilted table.

Hole cutters, which are a new type of expansion bit, are available for drill-press use. They can be set to cut any size hole, as shown in Fig. 7, and they bore rapidly and cleanly in wood, plastic, and thin metal. Use the lowest speed for metal.

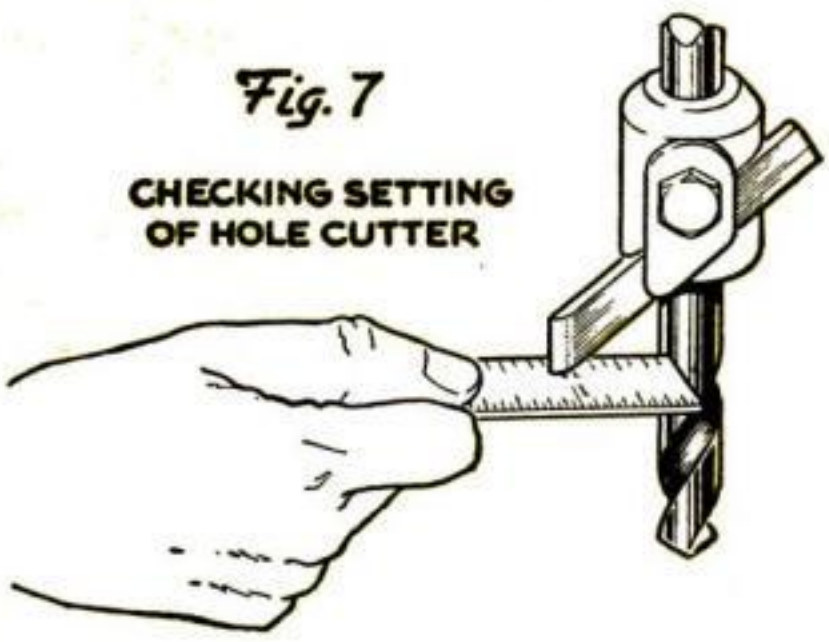


Fig. 7 CHECKING SETTING OF HOLE CUTTER

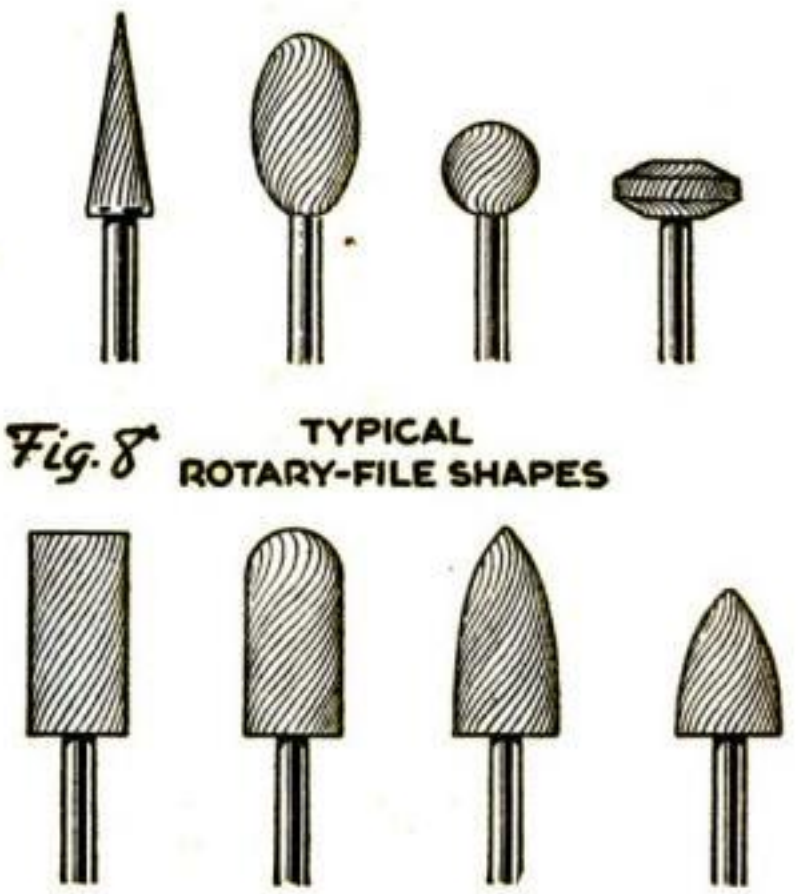
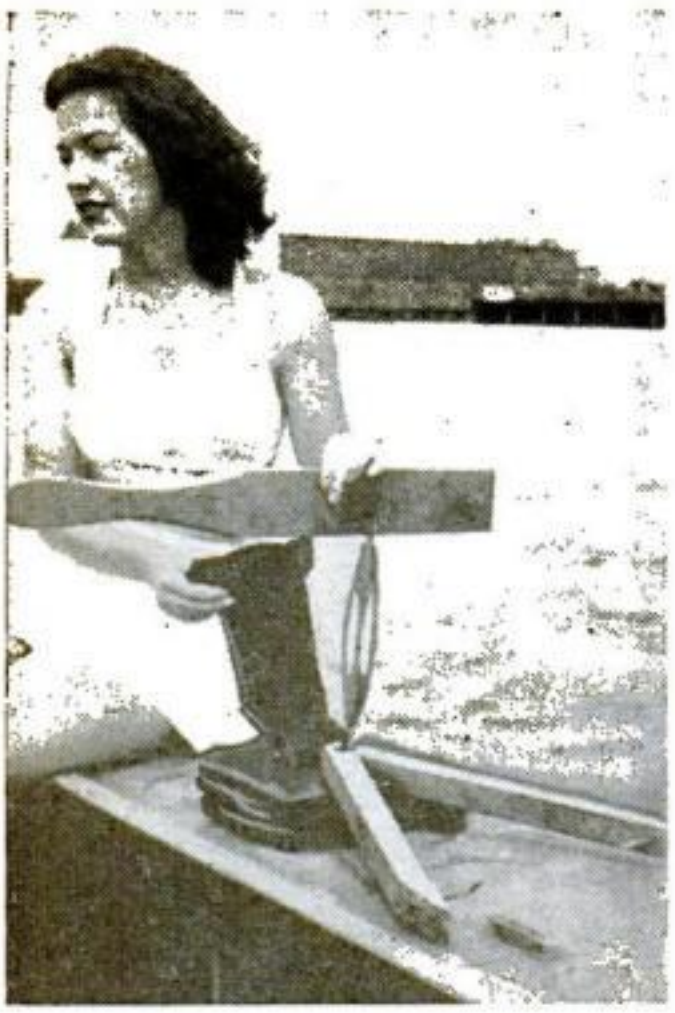


Fig. 8 TYPICAL ROTARY-FILE SHAPES

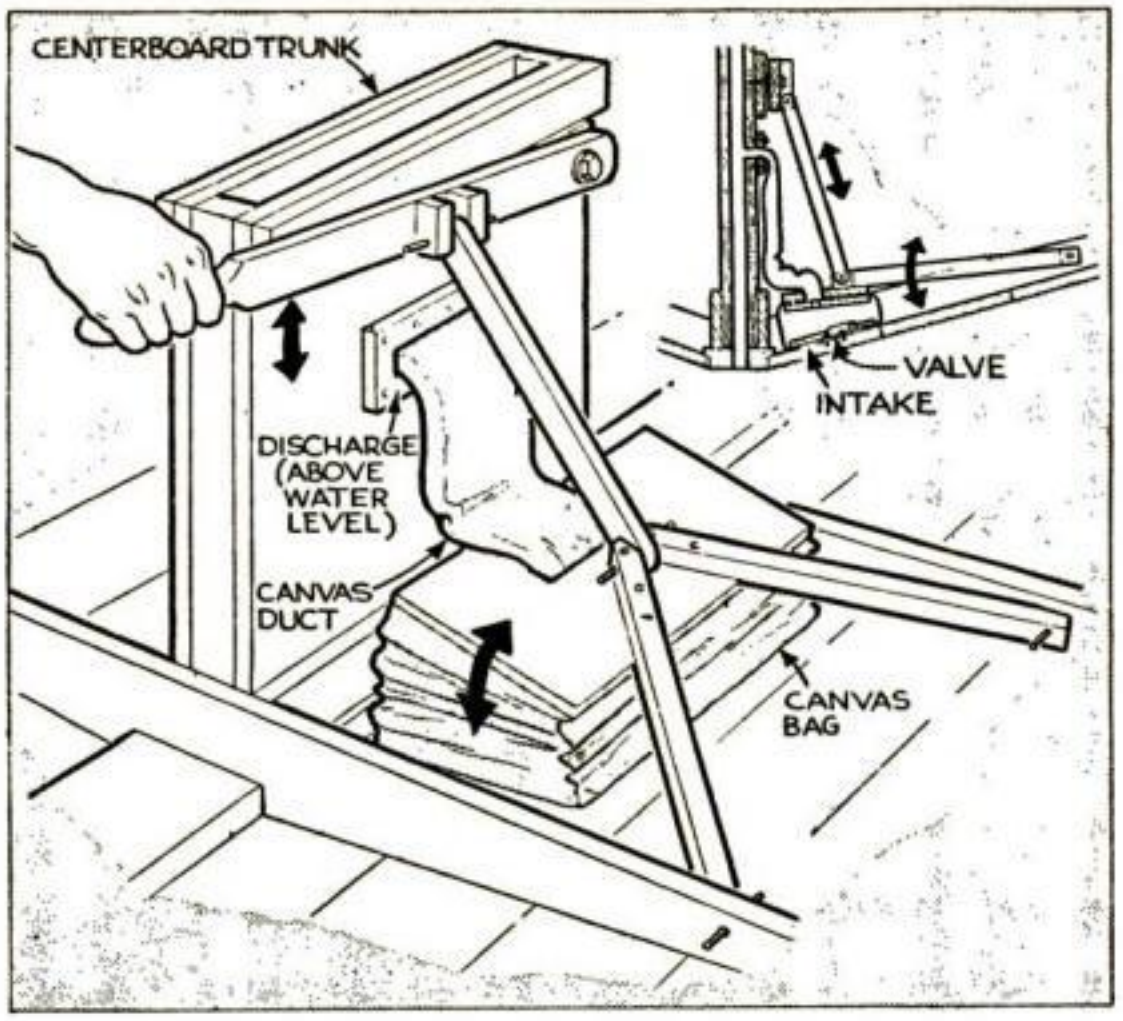


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# Bilge Pump with Bellows Discharges into Centerboard Trunk



This view before installation shows the parts of an efficient bilge pump.

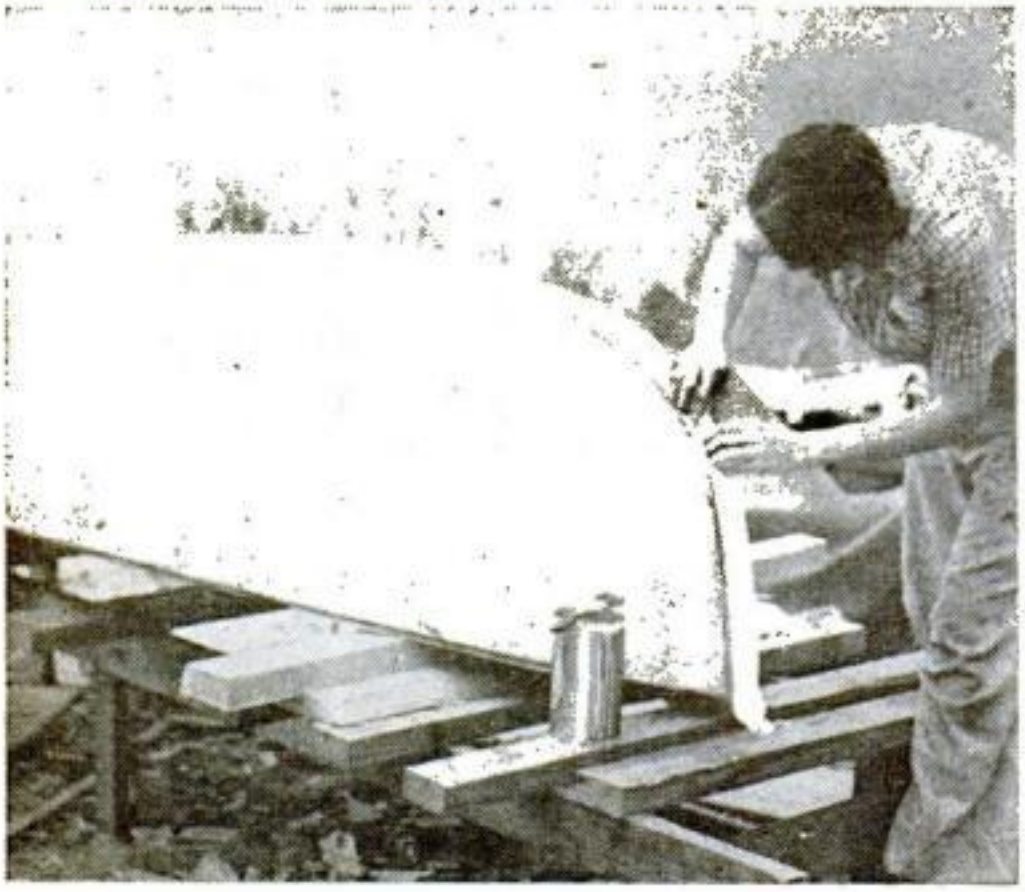



Here is how the pump works. With the intake near the keelson at the low point of the bottom, the boat is kept virtually dry.

THE bilge of a small sailboat may be easily kept dry with a homemade pump like the one shown above. Water enters the pump bellows from beneath and is discharged into the centerboard trunk.

For the bellows, make a canvas bag with folded flanges sewed inside its open ends. Tack it to a waterproof-plywood bottom piece cut U-shaped to provide an intake area. A leather flap valve closes the intake when the pump handle is pushed down. Secure the upper end of the bag between two plywood top boards with another flap valve to hold the water in the discharge duct. Two brackets screwed to the planking grip the bottom board inside the *U* and permit sliding out the unit for removal. Dimensions may suit the boat. For easy action, the pump handle should be a lever with a 3-to-1 ratio.—JAMES L. FINCH.

# Fabric Backing Strip on Re-Covered Canoe Helps Stop Leaks



When a canvas boat or canoe is being re-covered, there will be less chance of its leaking if a 3″ wide strip of light canvas or heavy muslin is first bedded over the stem in heavy paint or marine canvas cement, whichever is being used for the job. The strip should be long enough to reach back to where the V-section of the stem begins to flatten out. It provides a backing where the covering must be slit back for lapping over the stem.

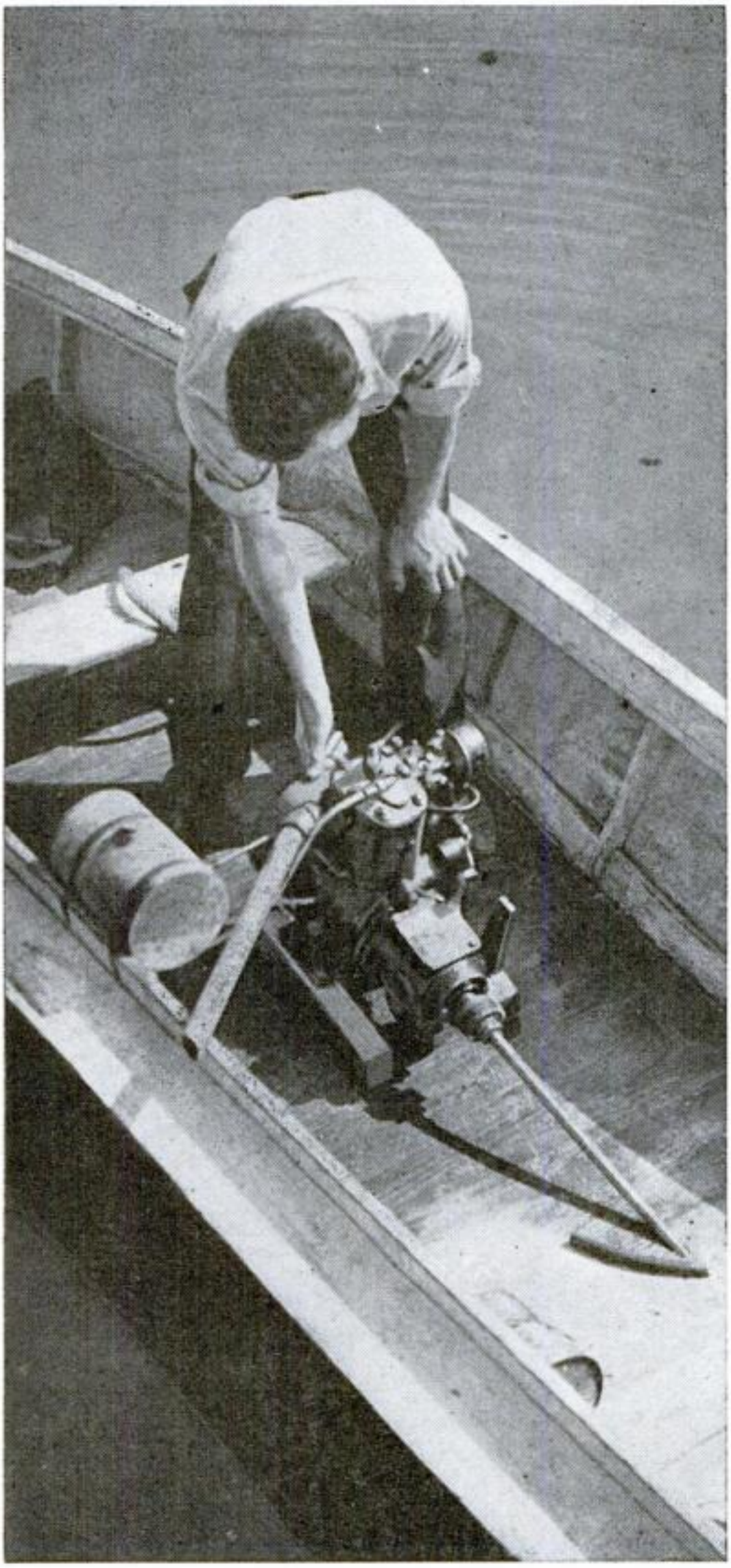
Don't use tacks to hold the covering itself except on the face of the stem where they make it secure, but bed it instead in plenty of paint or cement. When a canoe is being recovered, the stems at both ends require fabric backing.—J. A. E.



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# Inboard Engines for Small Boats

## PROS AND CONS ABOUT POWER PLANTS FOR SMALL BOATS WITH HINTS ON THE INSTALLATION OF INBOARD FITTINGS



Note simple installation of this engine in a flat-bottom skiff. It takes little space and is readily accessible.

**By J. A. Emmett**

WITH a variety of small marine engines back on the market, many boat owners will be considering whether an inboard will suit their purpose better than an outboard. Some may want to put an engine in a boat they own now; others may be contemplating purchase of a new boat with engine installed.

But will such an engine be easy to start, dependable in operation, and economical to run? What speed can be expected? How about the cost? Is the boat now owned suitable to take an inboard engine, and if so, what work will be involved in installation?

Small inboards never were intended to displace the handy outboard motor entirely, and they never will. Both types have their place in the boating picture, and it is impossible to make a general statement of the merits of either. Each has its advantages and disadvantages, but much depends on contributing factors—the type and size of the boat, its construction, the purpose for which it is wanted, the waters on which it will be used, and even the place in which the boat will be kept between periods of use.

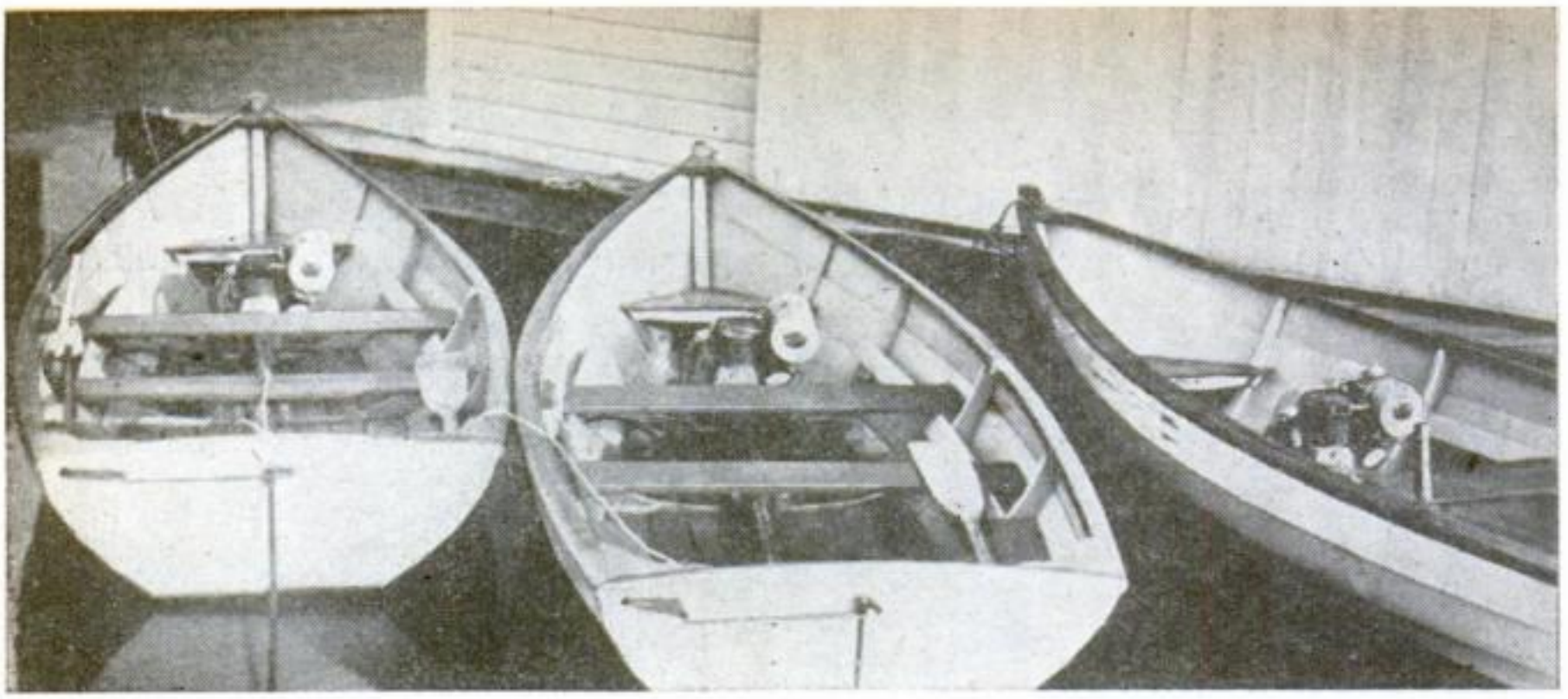
Often an outboard will be found more satisfactory for a very small boat and for speed in a fair-sized one; an inboard of up to 5 hp. may be just the thing for a larger, chunky boat and for a utility or general-purpose craft.

One of the least handy features of an inboard is its weight. Such an engine may not actually weigh much more than an outboard of comparable power but, since it can hardly be removed when the boat is handled on land, means more dead weight. Draft may be increased as much as 1′ by the propeller, projecting skeg, and rudder. While the inboard-powered boat may not require any greater depth of water in actual operation, the handy tilting feature of the outboard is lost.

Thus weight and draft can make an inboard engine unsuit-



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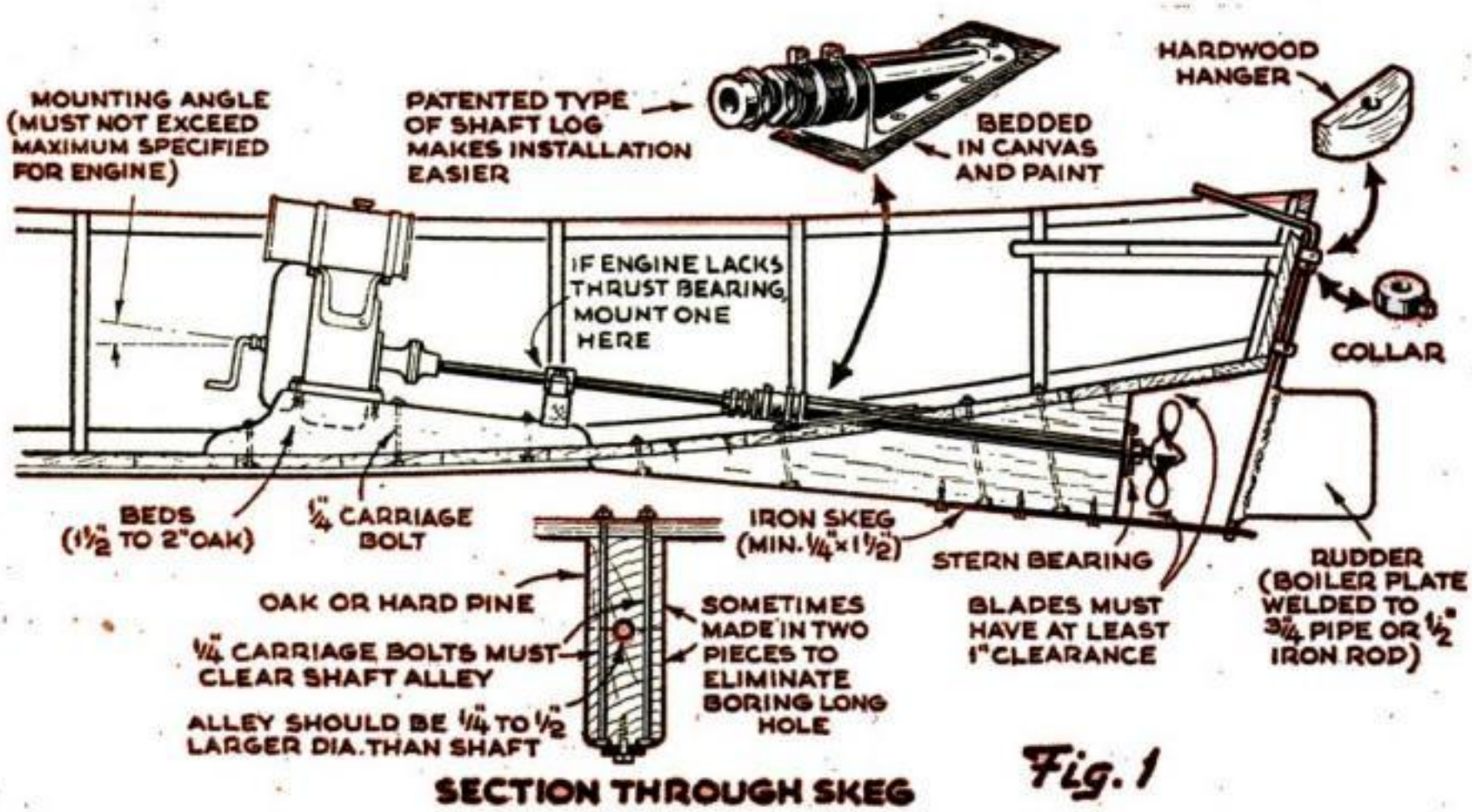


Modern inboards are compactly installed, leaving plenty of room for passengers even in boats like these.

able for such small craft as the car-top or trailer-hauled boat that is usually transported to and from near-by bodies of water and conveniently launched and taken out again. But where no shallow bars or rocks will interfere with running, no snags and floating debris are apt to be encountered, and the boat can be kept at a dock or mooring with ample water under it at all times, the inboard comes into its own. It is just the thing, too, for long runs, especially on water large enough to get rough at times.

Easy starting, dependable operation, and cheap running and maintenance can be expected if the engine is correctly installed and given ordinary care. No engine is entirely foolproof. Certain precautions must be taken and attention given even though the average inboard is not subjected to the harsh treatment of most outboards. It does not have to take the tilting, jolting, and bumping that most outboards receive in shore handling, and as a result engine adjustments, including that of the carburetor, are not apt to be disturbed.

Weight and size are not as great a disadvantage in an inboard as they are in an outboard, and heavy-duty inboards can be expected to have a long life. Such recent features as air cooling may mean less trouble from corrosion and rust, especially in salt-water service. Not having to mix oil with gasoline will be considered an advantage by many. Fuel consumption is economical, thanks largely to four-cycle operation. And for the same reason starting is normally






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a great deal easier and is more dependable.

Though small inboards are generally designed to turn up a high speed, they are not intended to drive boats fast, and it is often necessary to step down speed through a reduction gear. Or it may be wise to choose a slower-turning engine to permit operation of a propeller large enough to drive a chunky boat efficiently.

About 7 to 9 m.p.h. is enough to expect of hulls suitable for powering by inboards. To attain this speed, a 10′ boat may require a ¾-hp. inboard, an average 14′ skiff one of 2 hp., and on up to say 5 hp. for a 20′ craft. Engines of these sizes weigh from 50 to 200 lb., and the prices uninstalled are from $75 to $200. Added to the initial price, however, must be the cost of fittings. Unlike the outboard, which comes complete, an inboard will need a number of extras, principally a drive shaft, coupling, propeller, stuffing box, and outside bearing or strut. Then the engine must be mounted on beds, a rudder fitted, and perhaps some means provided for protecting the propeller from damage.

For most models the fuel tank must be installed up in the bow or beneath a seat with gravity flow to the carburetor. Air-cooled engines usually have the exhaust fitted with a muffler. You may want, or in the case of a water-cooled model have to, lead the exhaust through the side of the boat or the transom. Water-cooled engines also must have a cooling water supply from a simple through-the-hull fitting in the bottom of the boat and a discharge through the side or into the exhaust line. Incidentally, aside from cost, an air-cooled engine is easier to install and does not require draining in freezing weather. Good ventilation is necessary, but in an open boat any box protection may have the ends open or be folding or demountable.

But back to cost—even if you make the installation yourself, you can see that you must add a number of extras in your estimate. It may be a good idea to compare your figures with the prices asked for several makes of general or utility runabouts complete with engine installed. Most ready-made jobs include a reverse gear or clutch for easier starting. With it, the engine can be warmed up in neutral at the dock and shifted into forward speed, or a boat may even be stopped or handled in reverse. This is much more convenient than the straight-ahead starting of outboards and may be well worth considering whether you install your engine yourself or buy the complete outfit, even though it may add $50 to the cost.

Type of hull must be considered first if you intend to install an inboard in your present boat. In general an inboard cannot be installed satisfactorily in a hull meant for outboard power—it is a matter of basic design, since the true outboard runabout necessarily has its point of greatest bearing aft, not forward where it is needed for inboard power. This should rule out the inboard for all rather fast outboard-runabout types, but there are many others in which an inboard will work satisfactorily. Boats intended primarily for rowing or for small outboards are good. They have conservative hulls with good bearing amidships and not too much fullness →

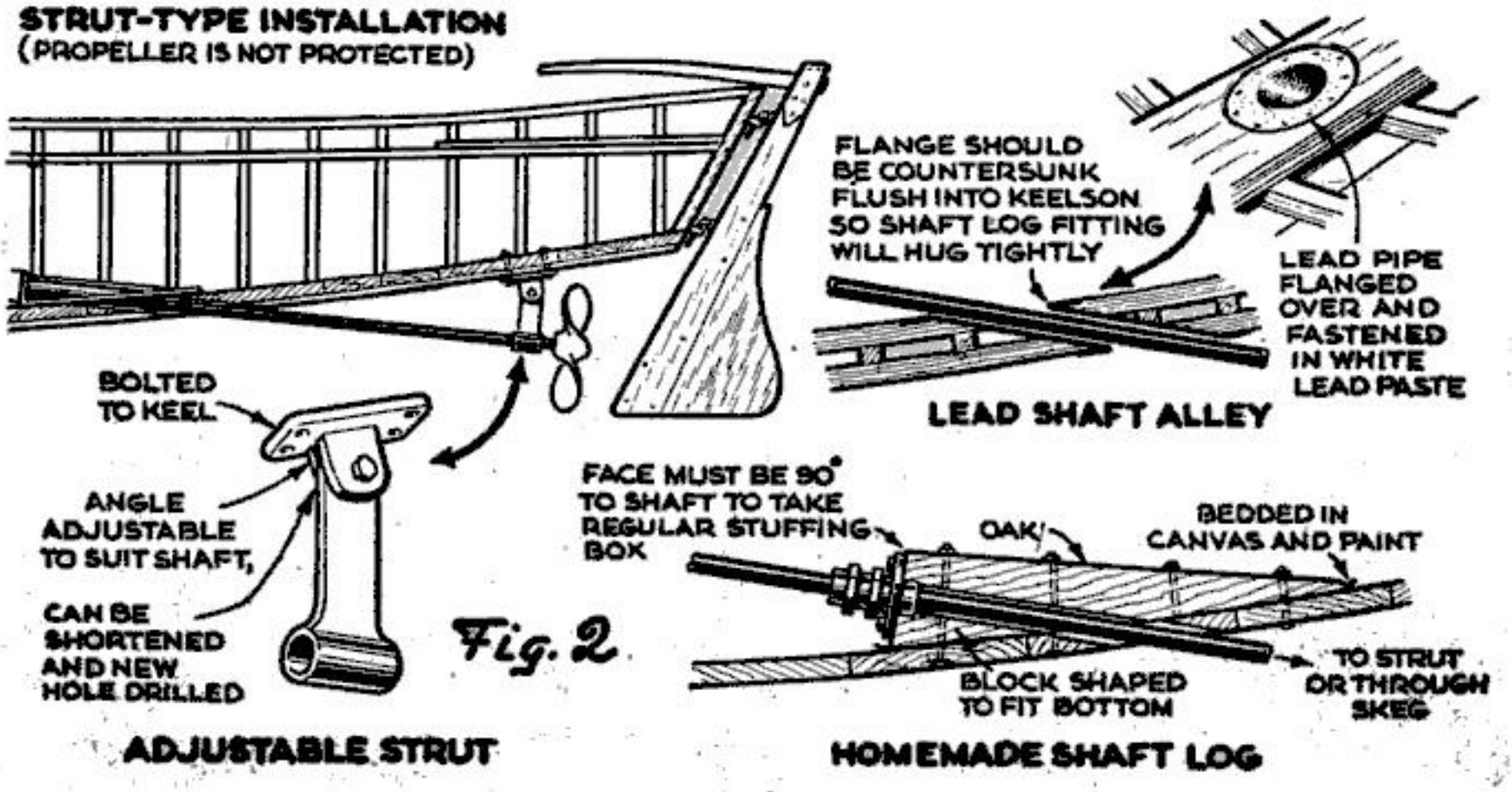



Fig. 2



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aft. The common flat-bottom skiff is an especially good boat for an inboard, and its construction is usually such that it will not complicate the work of installation.

Figure 1 shows the fittings most often required and indicates the necessary work. The mounting angle of the engine will be in the manufacturer's specifications—probably 10 deg. normal and not more than 15 deg. maximum. This must be kept in mind in the early planning of the layout, for it is best to avoid having to use a universal joint in the shaft line. You must decide how far forward to set the engine so its shaft line will pierce the hull at a point that will leave clearance astern for the propeller and still not have the engine at more than the specified angle.

On some makes of inboard the flange taking the hold-down bolts is in line with the center of the shaft; on others, especially on models having a reduction gear, it will be lower, as shown in the drawing. These flanges set the height of your two beds, which should be cut accurately to hug the bottom and bolted in place at the proper distance apart. Particularly for a larger boat, the beds should be long enough to distribute the load of the engine over a good portion of the bottom.

It is a good idea to make a full-size plywood profile of your engine from the dimension sheet, attach two crossarms at flange height, and set it on the beds to represent the engine. The hole for the shaft can then be cut in the bottom at a point that will permit lining up with the engine. Get the hole as nearly correct as possible, but final alignment will have to be done with shims or by chiseling after the shaft has been installed in its stuffing box and outer bearing or shaft. The patented type of stuffing box shown in Fig. 1 simplifies installation, but a homemade wooden shaft log can be installed as in Fig. 2 and used with a regular stuffing box.

A wooden skeg can be made up, as shown in Fig. 1, and bolted to the bottom of the boat to take an after bearing, or an adjustable skeg can be used. The former requires a shaft hole bored through its length. If it is made in two lengthwise halves, the shaft alley can be hollowed partly in each. Bolts holding it to the hull must, of course, clear the alley. An iron skeg or shoe can be fitted on to protect the propeller against the bottom and drift.

Advice on the diameter and pitch of propeller can be obtained from the maker of your engine if you furnish him particulars of your boat. There must be at least 1" clearance for the propeller tips (Fig. 1).

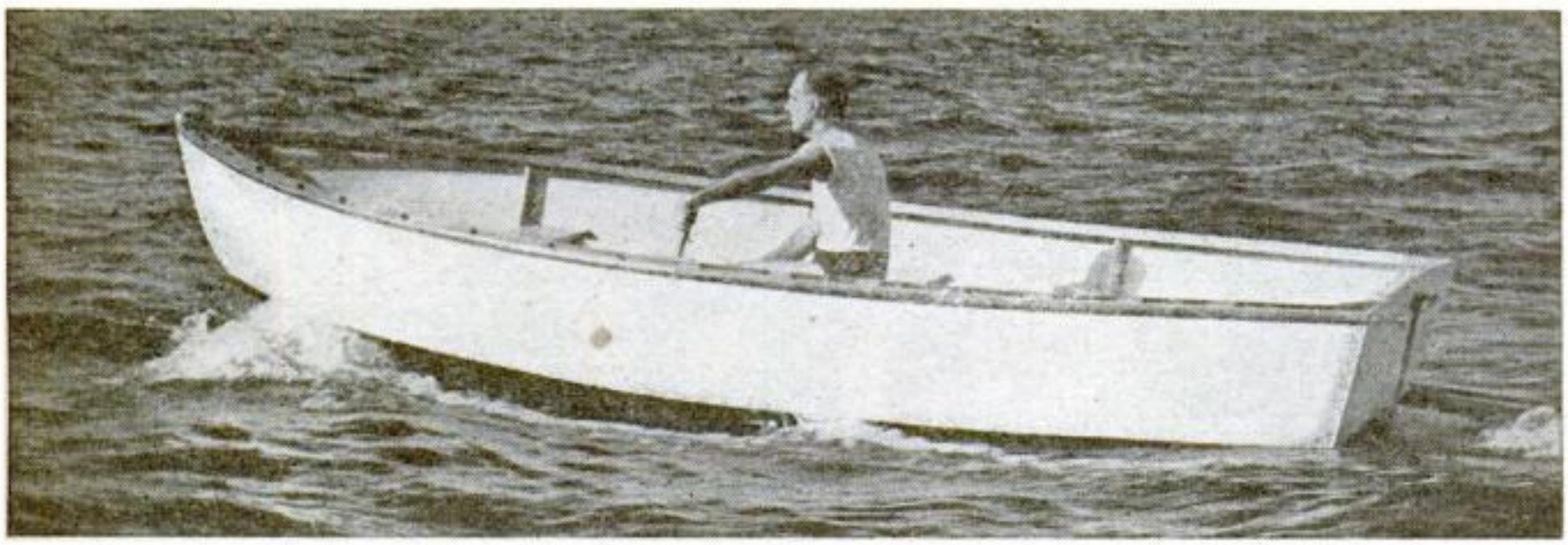
After final fitting of the shaft and installation of a thrust bearing if it is necessary, the engine is set in place on its beds and lowered or shimmed up until its coupling perfectly engages the other half of the coupling keyed on the inboard end of the shaft. When you are finally sure of accuracy, lag-screw the engine down.

Considerable attention should be paid to having alignment of engine and shaft just right, or the engine will not perform satisfactorily. It will be wise to check a few times during the season if you have a light boat.

The rudder is installed last. It may be either metal or wood. The general shape will have to suit the slant of the stern.

An installation job can be complicated in a boat with bottom frames or ribs and a keelson, as in Fig. 2. One way to accomplish it is with a piece of lead pipe of an inside diameter larger than the shaft. Put the pipe through a hole cut or bored through everything at approximately the angle required, and then cut its end off on a slant and flange it down in white lead paste for a watertight fitting. An adjustable stuffing box or wooden shaft log is fitted over the inboard end. Many manufacturers of engines supply data on installation, and some provide stock fittings.

**This handy 16′ utility craft comes with its 2½-hp. inboard installed—a stock model complete and ready to run. Most ready-made jobs include a reverse gear or clutch for warming up in neutral and easy starting.**





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# Nonmarring Hammer Has Replaceable Lead Faces

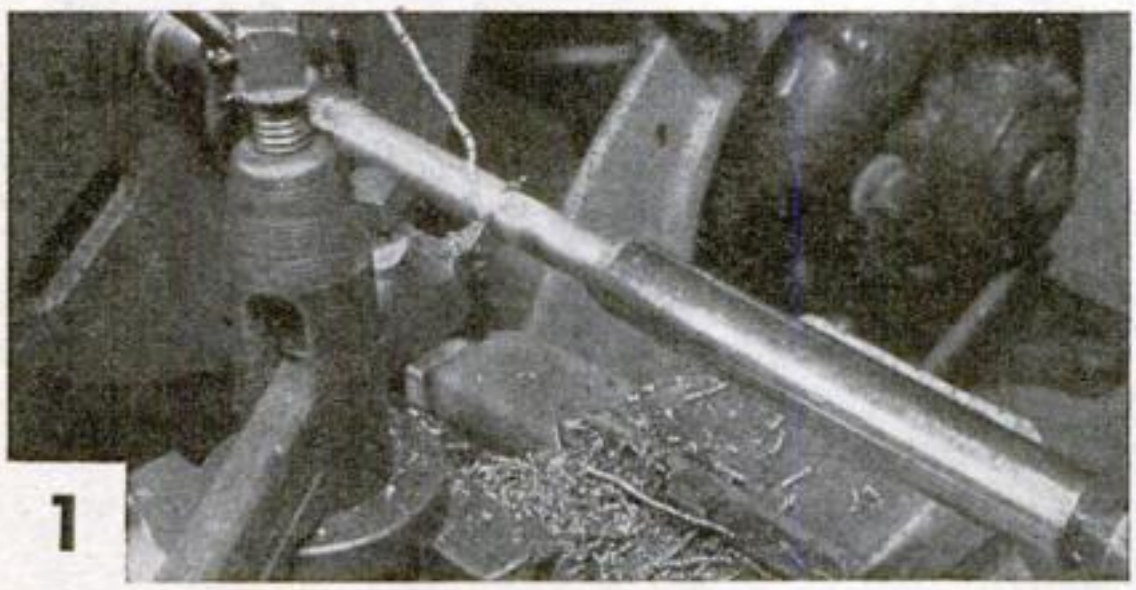


SOFT-FACE hammers, always valuable for work on surfaces that might be damaged by regular ones, have a place in every shop. This one employs lead faces that are cast in a simple mold and that can be unscrewed and discarded when no longer in usable condition.

The handle and the head are made of scrap pieces of steel or brass. First turn the handle to shape (Fig. 1) and knurl between centers, using plenty of oil and medium or coarse knurls (Fig. 2). Then cut it to length and drill the grip end to remove weight. A plug should be driven into the open end and faced.

Machine the head to shape between centers, cut it to length, and face and thread the ends (Fig. 3). Drill a hole for the handle, which should then be rechucked and filed lightly for a drive fit in the head.

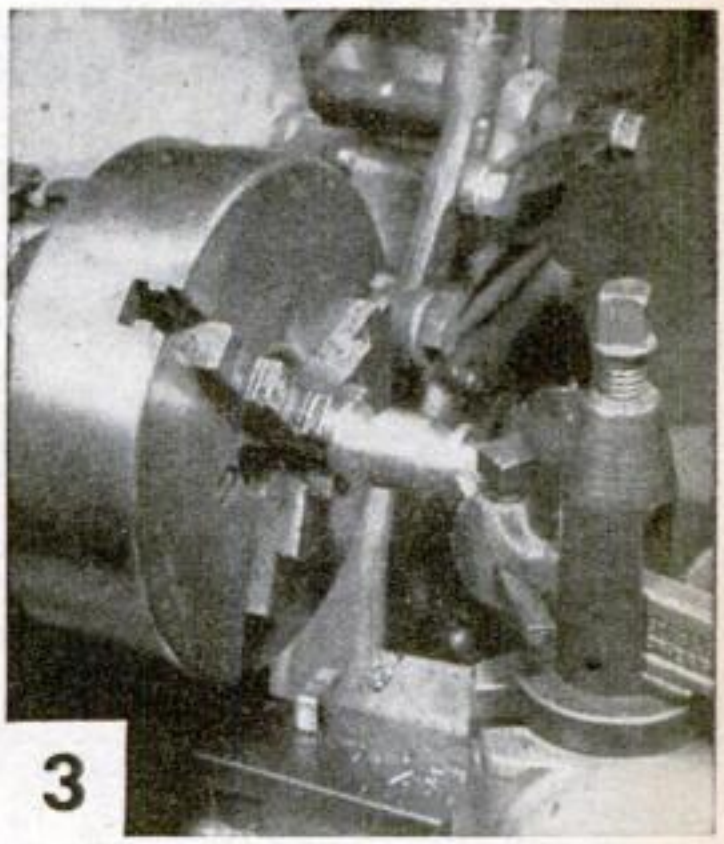
The lead faces are cast in a simple mold consisting of a hardwood block and the stub end of a ½"-13 bolt, as shown in Fig. 4. It should fit the block snugly but not tightly, and should be oiled before the lead is poured to eliminate any chance of sticking. After the lead has solidified, push through the bolt and the lead cap and unscrew the latter.—WILL THOMAS.



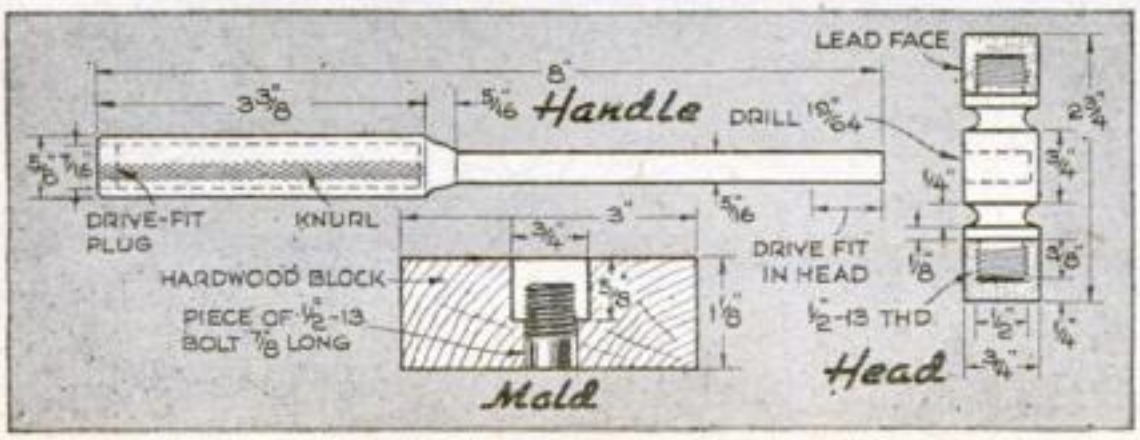
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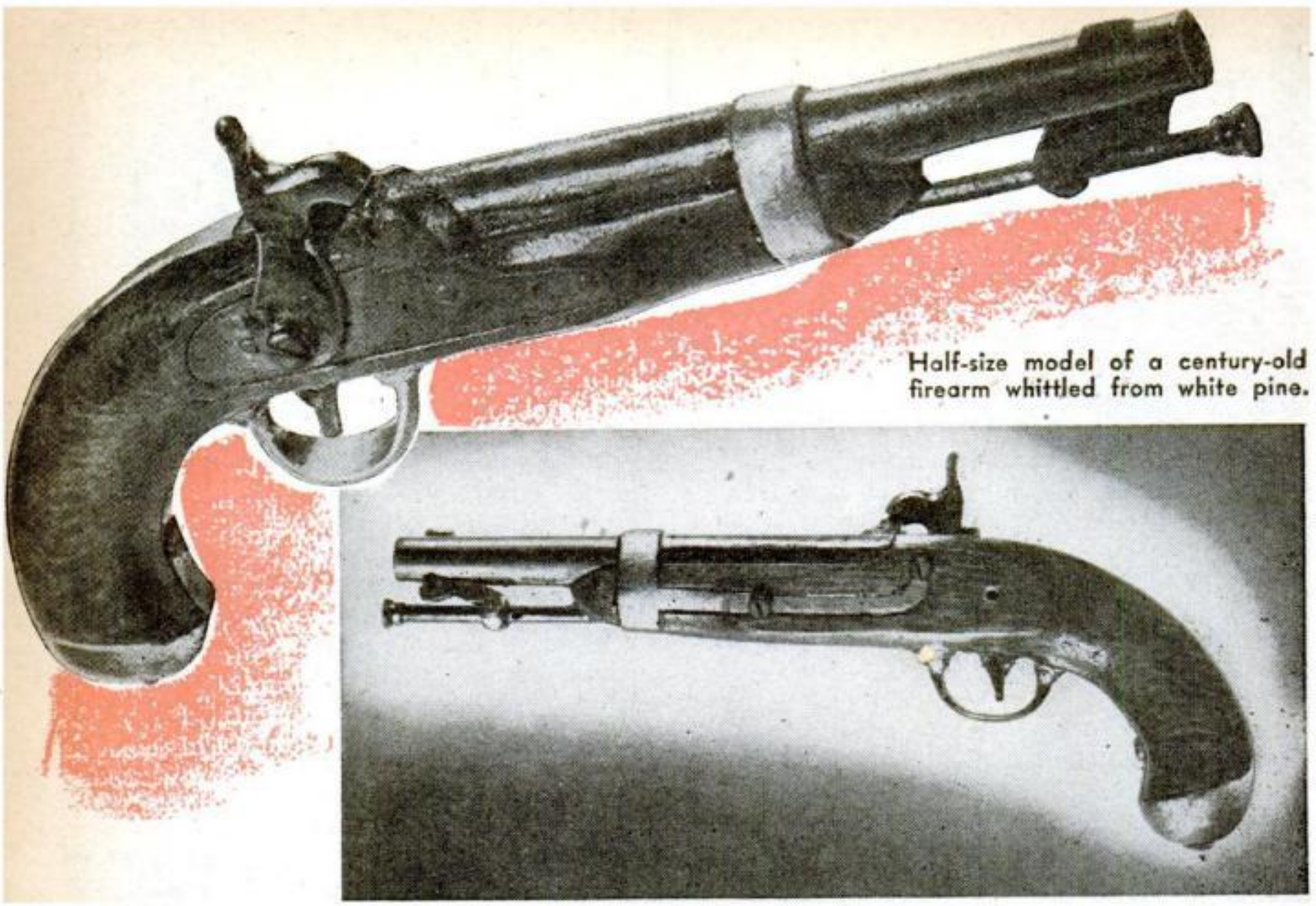





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Half-size model of a century-old firearm whittled from white pine.

# Carving a Cap-and-Ball Pistol

## 1847 Side Arm Carried by U. S. Troops in Mexican War

By Carl G. Erich

WHEN American troops set off to the war with Mexico nearly a century ago, this is the type of pistol that some of them carried. It is a quaint old side arm of the cap-and-ball type. Our whittled model is a true replica, finished to resemble the brass, iron, and wood of the real gun.

The model shown was carved half size, and the drawings are also half size, but the craftsman can readily double the dimensions for a full-size model if he prefers. For half scale, the layout can be traced directly from the facing page. Transfer the side view with carbon paper to a piece of white pine 13/16" by 2¾" by 7⅛", laying out the lines as accurately as possible. Jigsaw to shape outside the lines. An extremely sharp knife should be used for the carving. Shave close to the lines and be careful not to cut away too much at any one time. The templates will help you get the desired shape at the points indicated.

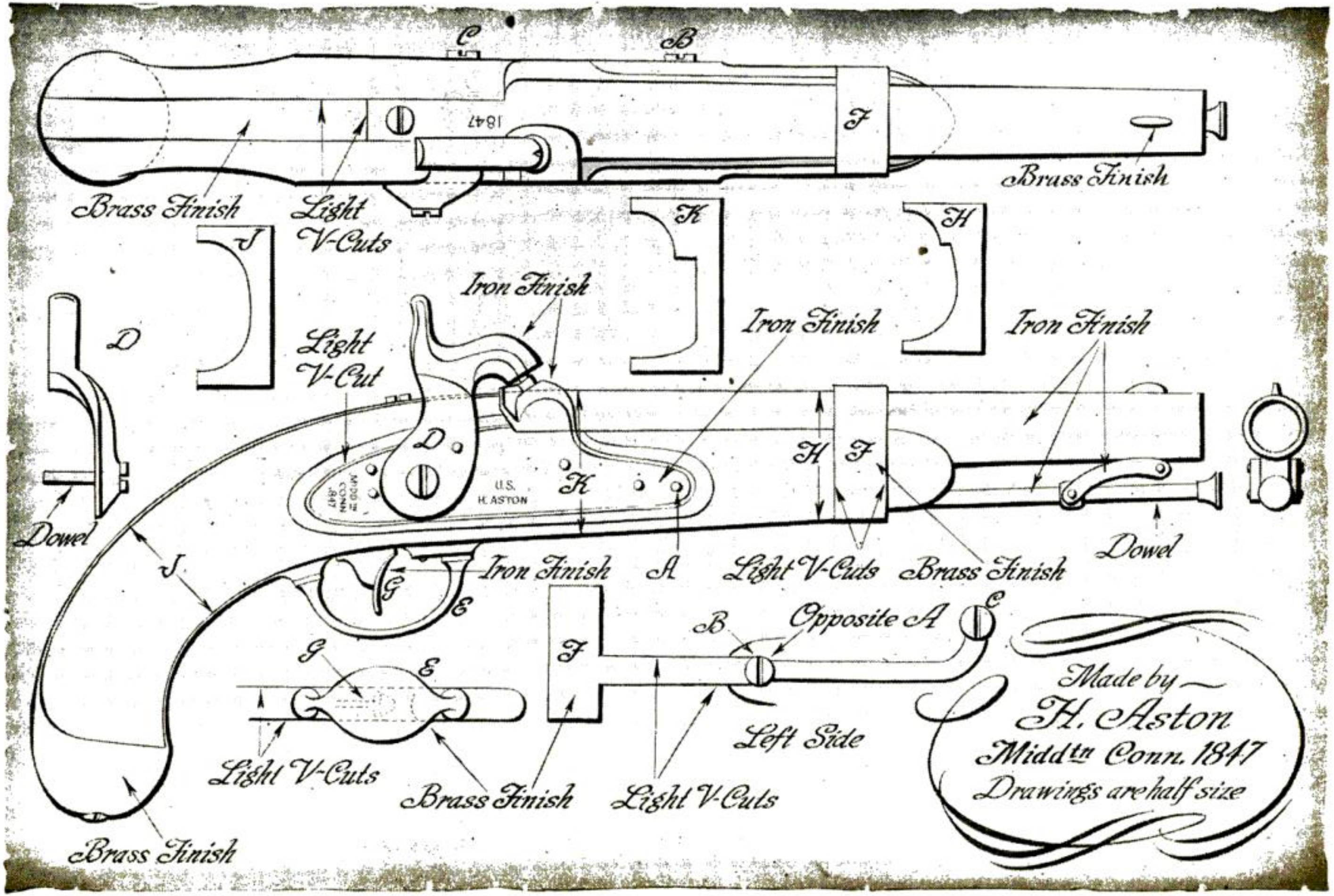
It may be best to shape the trigger and trigger guard last. Cut across the grain and you are less likely to split the wood. If a split occurs, glue the pieces back in place. Cut the hammer separately and attach it with glue and the dowel shown. The various screws may be made from dowels slotted at one end with a coping saw. For the ramrod, you may either use a dowel or carve it as an integral part of the model.

After the model is well shaped and sanded, coat the wood parts with a walnut oil stain. When this is dry, apply a coat of clear varnish to these parts. Give the "iron" parts a coat of liquid stove polish, then rub on a coat of dry or powdered graphite, and finally apply clear varnish to blend the graphite. Rub lightly with very fine steel wool when dry. Still another coat of graphite will make these parts look like bluish steel.

Paint the "brass" parts with a coat of light-yellow bronzing powder. When dry, rub lightly with steel wool and finally with powdered graphite.



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# The SAW That



Forming and blanking dies made on a contour bandsaw. When die and punch are cut from the same piece, waste is avoided. At bottom, a fanciful example of trick contour - sawing.



*Photos courtesy The Doall Company, Des Plaines, Ill.*

ONE machine with the versatility of a whole shop—that's the story of the contour bandsaw that solved innumerable problems in wartime industry. It looks like a heavy bandsaw, and it does the work of a bandsaw. In addition it does many of the jobs of a shaper, milling machine, nibbler, and lathe. But it probably reaches its peak in short-run "stampings" and short-run "forgings," for often it can machine finished pieces of this kind in the time it would take to make the die or pattern alone. It can also make dies, punches, and die shoes —all three in one operation—and jigs and fixtures, special parts, templates, and cams. It cuts wood, plastics, rubber, and both tough and soft metals.

The machine is a combination bandsaw, band file, and band finisher. It uses new, narrow saws and has a built-in butt welder for welding the blade ends in internal sawing operations where the saw is cut and inserted in a hole in the work. Removal of the saw and substitution of a file or emery-cloth band convert the machine to power filing or polishing.

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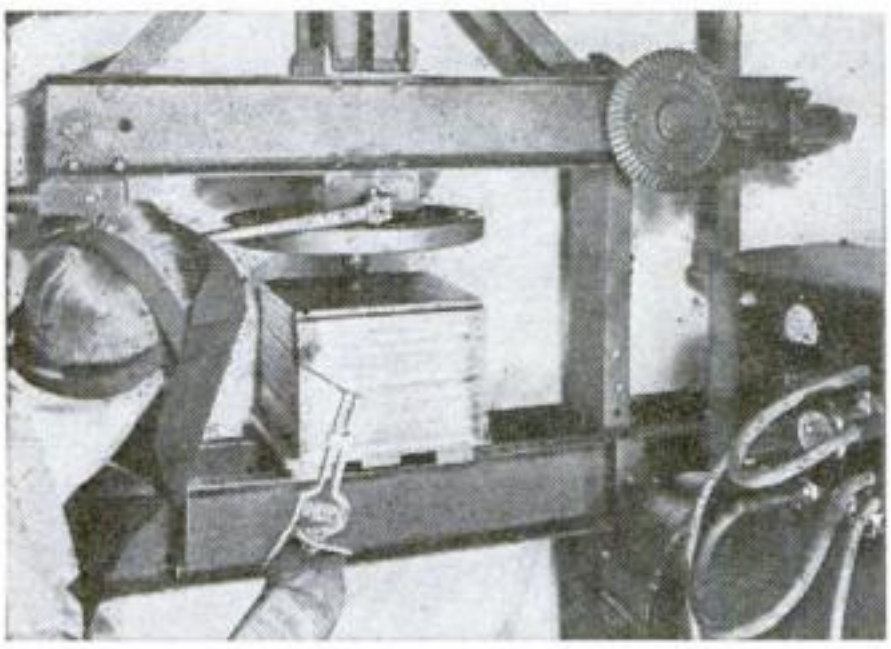
# Cuts Corners for Industry

In shaping and milling jobs, the contour saw slices off the entire section to be removed in one operation, cutting a 1/16" wide slit in the material rather than reducing the waste to chips in what on other machines is often a series of slow cuts. Instead of biting out a rough design with a succession of punch strokes as a nibbler does, the contour saw leaves a clean, finished edge. Whereas a nibbler is limited to sheet metal and thin plate, blocks 8", 10", and 12" thick, depending on the capacity of the model, can be handled on a contour saw.

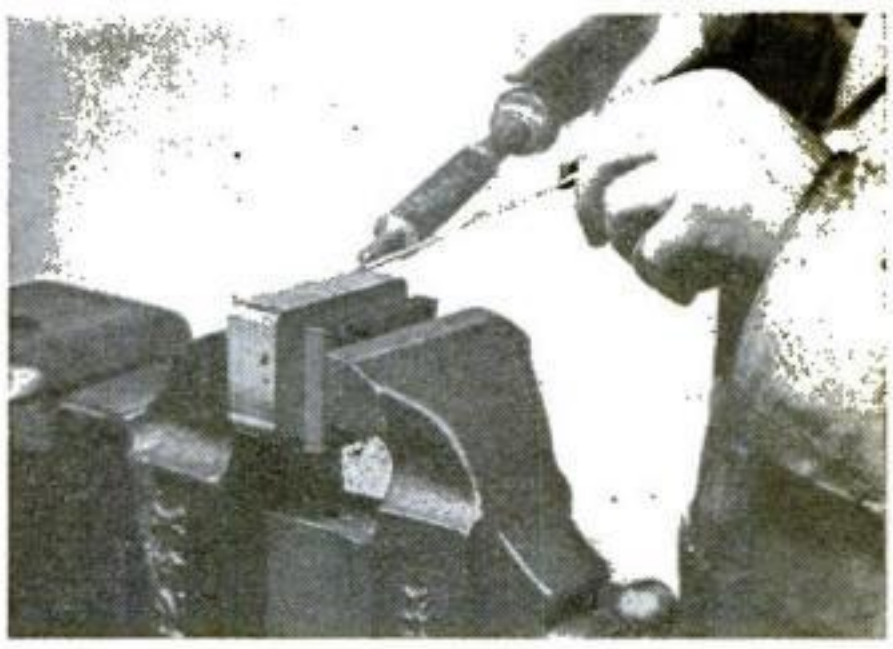
True circles are cut on the contour saw by revolving the work on a fixed pivot, turning it into the saw just as into a lathe bit, with the difference that the saw cuts its narrow slit where the lathe tool makes chips of the waste. The diameter of the turning is not limited even by the throat of the machine, since the pivot is set up on the outside.

Short runs requiring the making of 50 to 500 identical parts, far too few for anything approaching mass-production methods, can be accomplished without dies. The metal sheets are first stacked and welded or soldered together in an arbor press or bench vise, the layout is put on top, and then all the pieces are sawed at one time. Intricate shapes may be cut with the same ease as simple ones. An entire "forging" can be sawed from a single block, or the parts can be sawed from plate and then welded together.

Cutting three or more die parts is possible in one operation, the die from tool steel the stripper from cold rolled steel, ➧

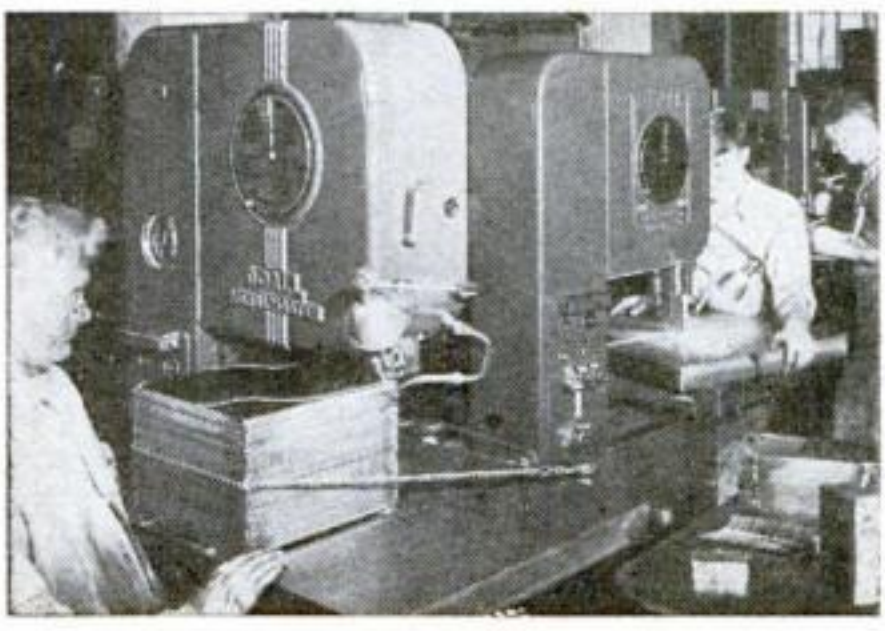


For multiple sawing, metal sheets are compressed and welded at the corners into one compact block.

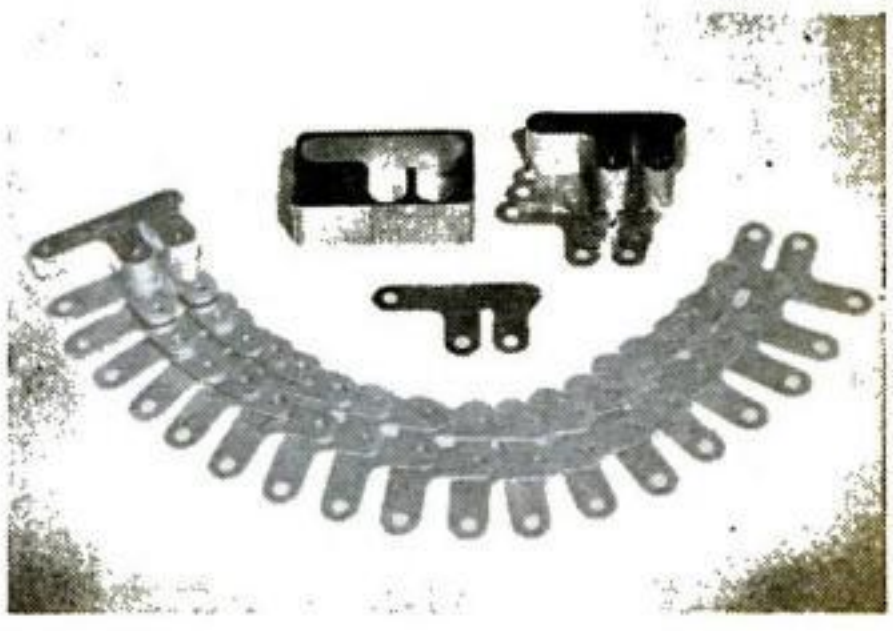


Small or thin sheets to be sawed into blanks are compressed in a bench vise and soldered together.

Here 65 blanks are being cut from a single stack within ½" of full-capacity height of the machine.



Electric-switch parts sawed out in one operation. The pattern is laid out on the top of the stack.





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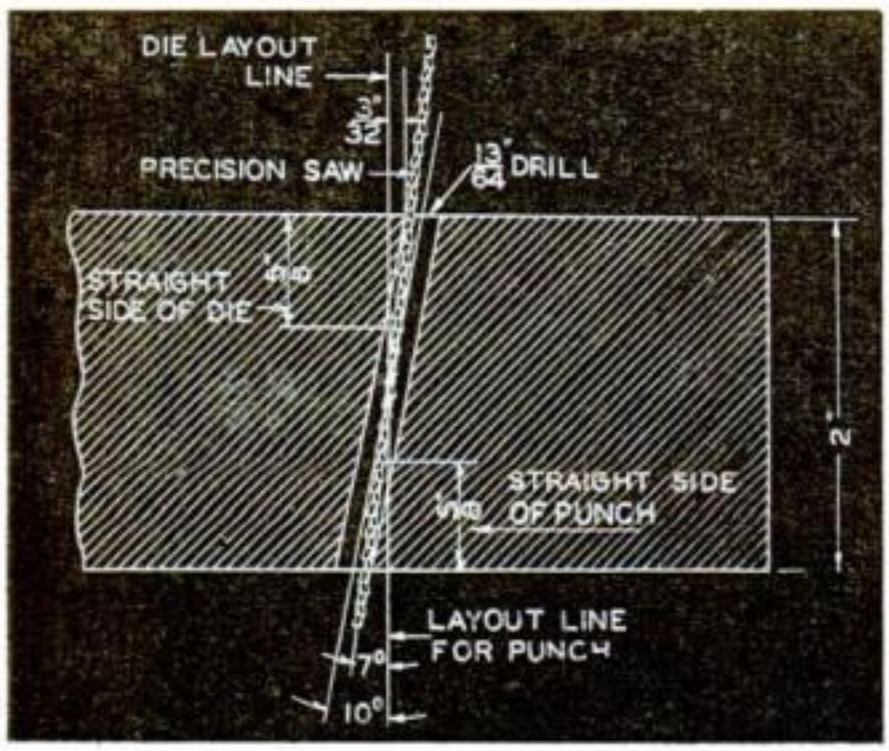


Blanks for a die, stripper, and die shoe are cut simultaneously, and then finished individually.



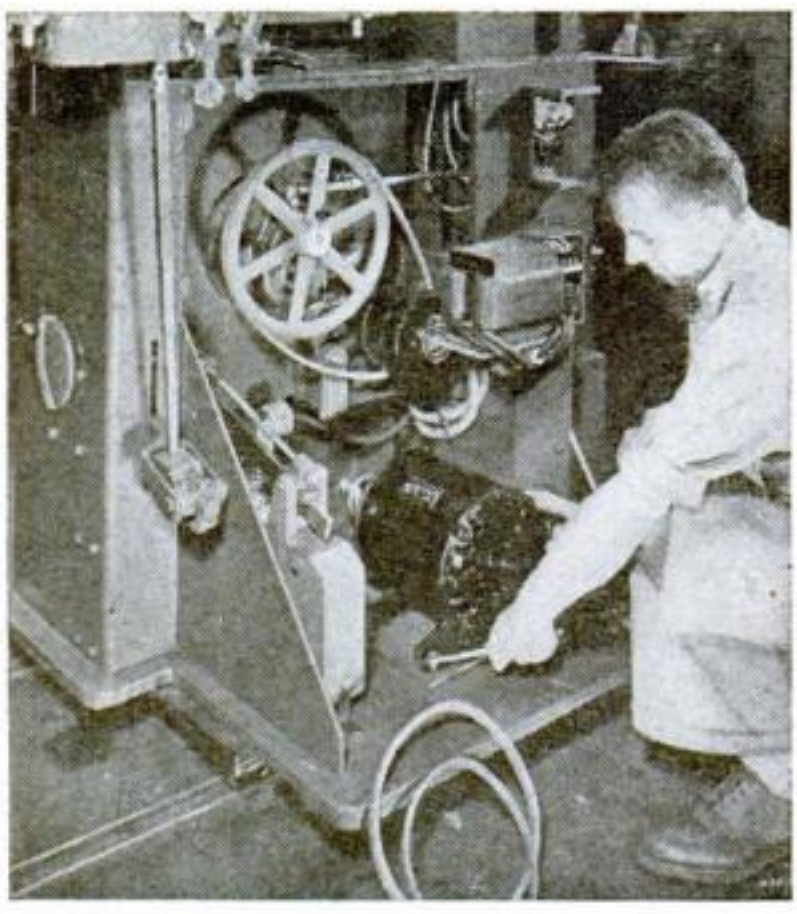
This punch and die were made from the same piece, the part removed from the die forming the punch.

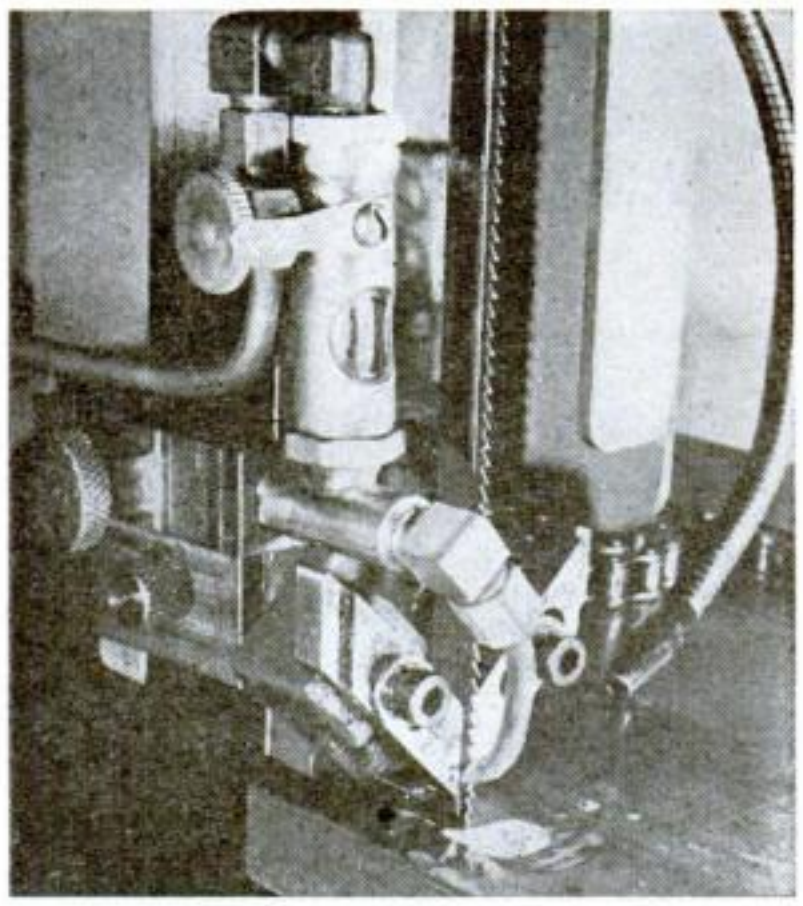
Drilling the starting hole at one angle and sawing at another permit use of the waste as the punch.




No sign of the holes is left after band-filing to size, except on the clearance side of the punches.







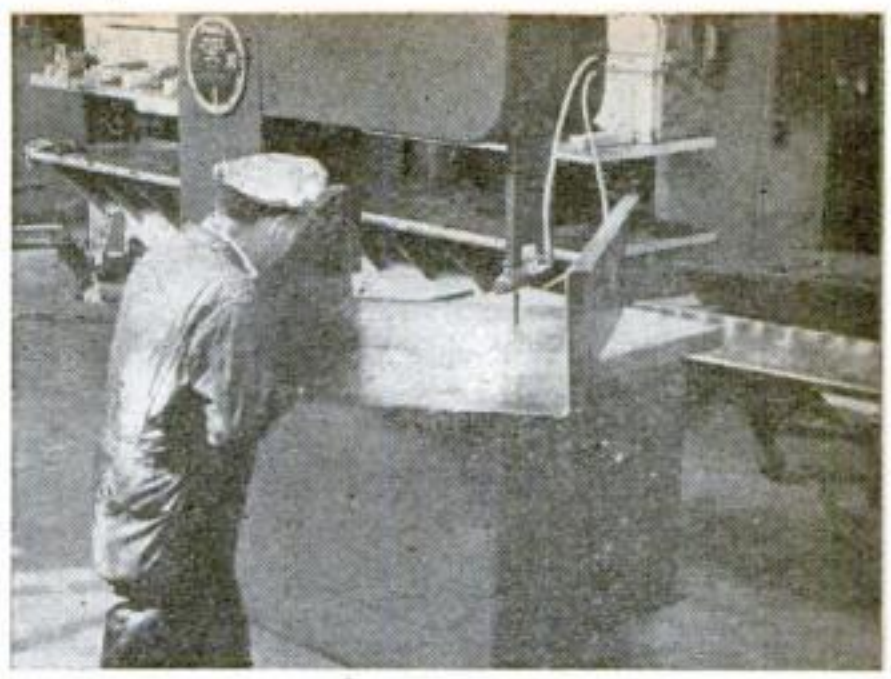
What's on the inside—motor, transmission, speed and feed controls, and butt-welder wiring—is shown at the left. Right, a close-up of the saw, saw guide, air jet, and precision lubricator.



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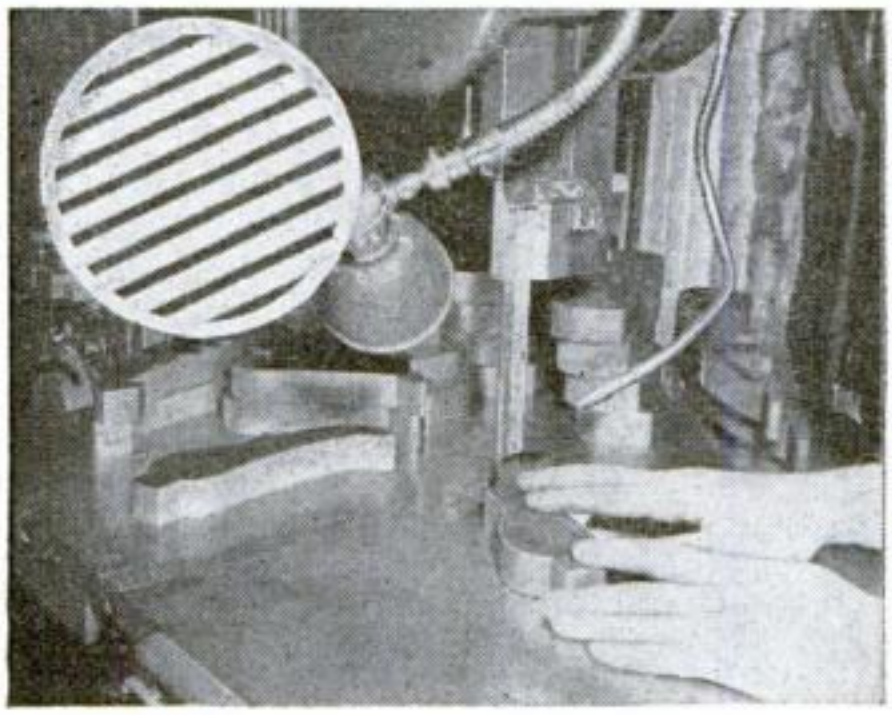


Industry finds many uses for the contour bandsaw. Here a high-speed machine slices cakes of dry ice.

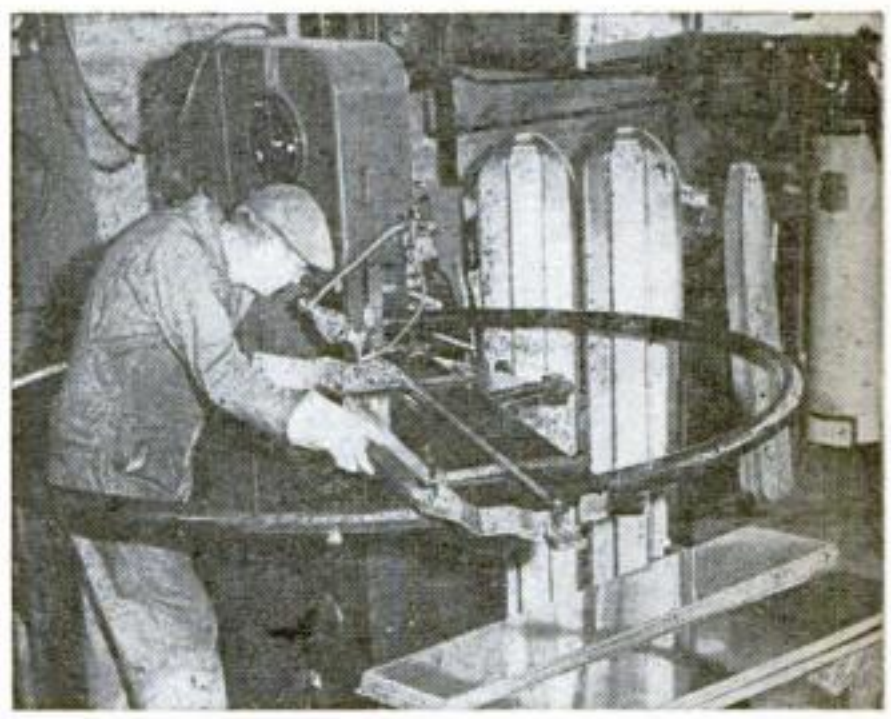


Friction-cutting steel plate at a speed of 7,000' a minute. A cut 60" long can be made in a minute.

Below is the setup for band-filing. In the inset are the file teeth. A polishing band is also used.

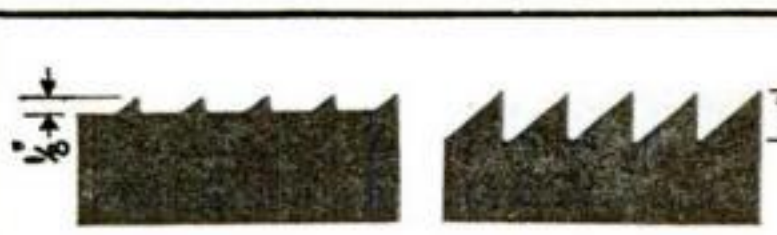


Machining airplane skis from 12 aluminum sheets. The circular rail supports the end of the stock.



and the die shoe from cast iron. The slug cut from the die can be finished for use as the punch if the sawing is done with the table tilted at an angle determined by the thickness of the die. A starting hole for the saw is drilled at one angle—inside the layout line at top, intersecting it at the center of the stock, and emerging outside the layout line on the underside. The saw then cuts at a slightly lesser angle, leaving material to be finished off on the cutting side of both the die and punch.

Speeds of standard models of the contour bandsaw range from 50' per minute for cutting high-chrome, high-carbon steel to 1,500' per minute for aluminum. New high-speed models used with a special saw are capable of speeds of from 1,000' to 15,000' per minute, with its actual sawing speeds varying from 1,500' to 5,500' depending on the nature of the material and the thickness of the cut. Superhigh velocities are intended primarily for friction cutting, in which heat melts out the kerf, ½" steel requiring a speed of 10,000' and ¼" steel 5,000.'



New tooth design (left) gives coarse pitch on narrow blades, whereas standard cut of same pitch (right) would weaken saw band.



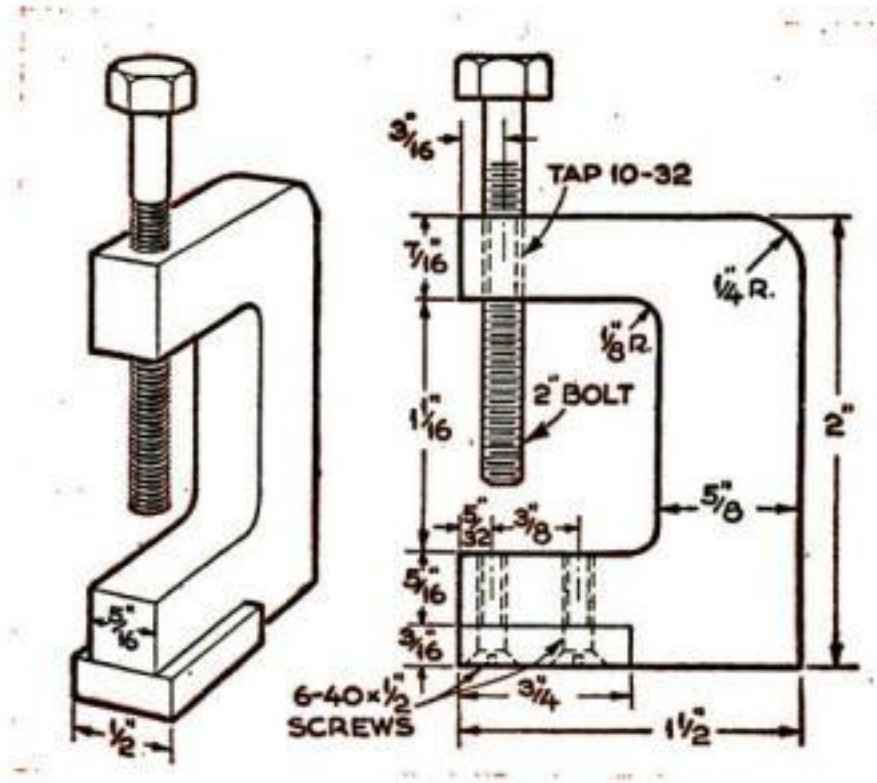
Chip production with a precision contour saw. Succeeding teeth bite further into the work.

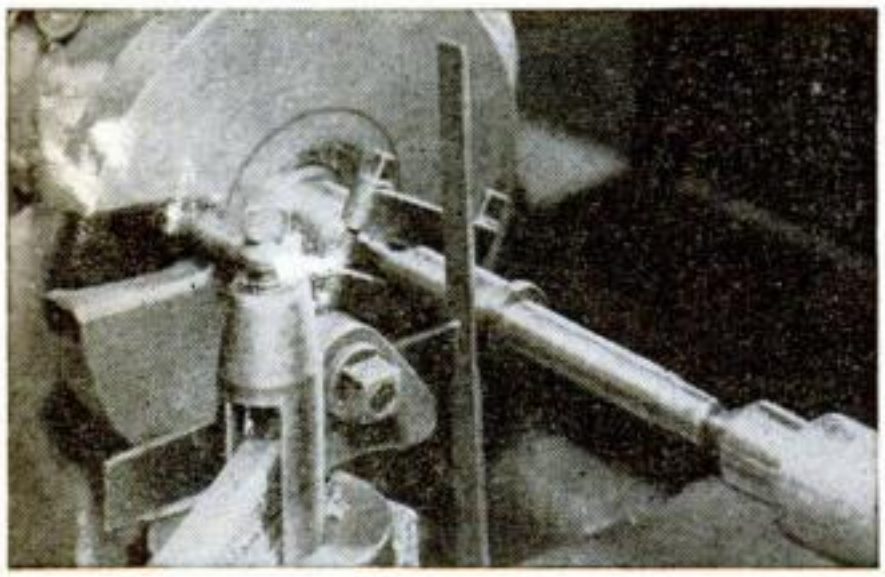


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# NEW SHOP IDEAS

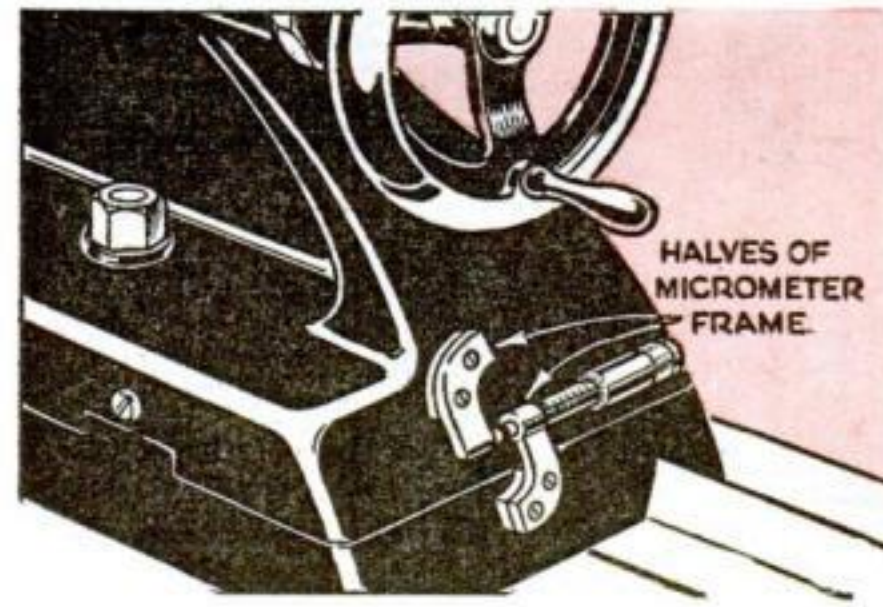
**SETTING THE CUTOFF TOOL** on the lathe at exact center height is important, since a slight error causes hogging or chatter. To adjust the tool to the proper height, place a pocket scale or other straight metal strip between the edge of the tool and the work, as shown below, holding it clear of the cross slide by light tool pressure. If the height is incorrect the scale will tilt forward or backward; when the tool is adjusted to the exact center height, the scale will be precisely vertical.—C. W. W.

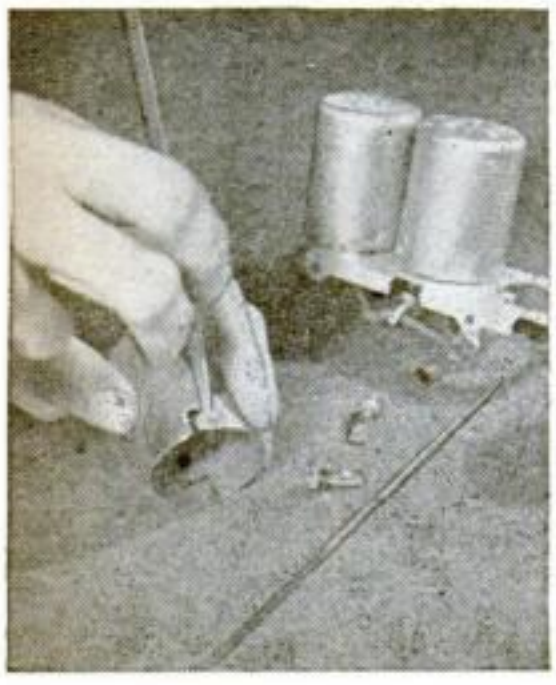


**MILLING-TABLE SETUPS,** ordinarily a matter of combining bolts, washers, nuts, hold-down bars, and spacer blocks, can be facilitated by clamps of the kind shown above. The body of the clamp is sawed from 5/16" cold-rolled steel, with a piece of 3/16" by ½" by ¾" flat stock held to the base by two machine screws. This forms an inverted T-shaped base to fit the slots in the milling table. Similar clamps of modified design could also be made for use on the drill-press table.—CHARLES M. CHAMBERS.

**TAILSTOCK ADJUSTMENT,** either to true alignment or to calculated offsets for taper turning, is easy with a micrometer mounted as at the right. An inexpensive die-cast one with an adjustable anvil will do. Cut the frame in half and bolt it to the tailstock so that, with the latter in alignment, the micrometer reads .500". This affords an adjustment of ½" either way. To avoid damaging the micrometer thread, always back the spindle clear, set over the tailstock, and then run the spindle up, reading from the .500" "zero".—G. EDWARD ANDREWS.



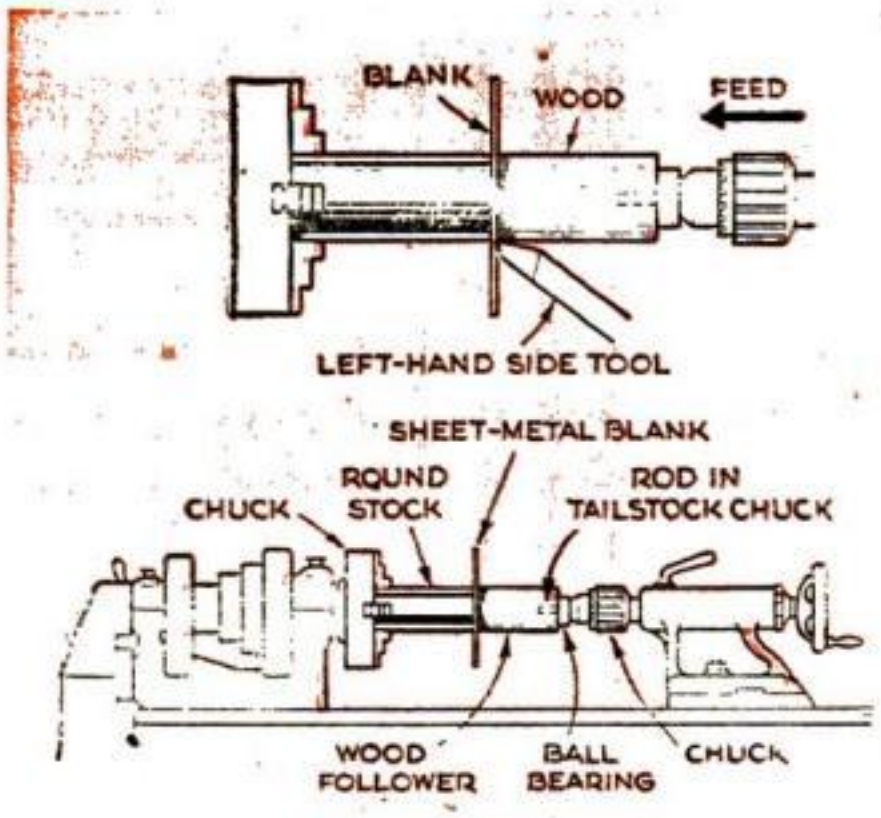



**TINY DRILLS** are easily lost or damaged unless they have their own case. An aluminum shield can from an old radio and a turned hardwood base will form an excellent protective case for drills smaller than No. 60. A brass or aluminum disk screwed to the base helps locate the fine holes in which the drills rest. Bayonet-type slots in the can engage two escutcheon pins in the base to lock the cover on. Use shellac or lacquer on the base and on the labeled can.—W. A. CONWAY.



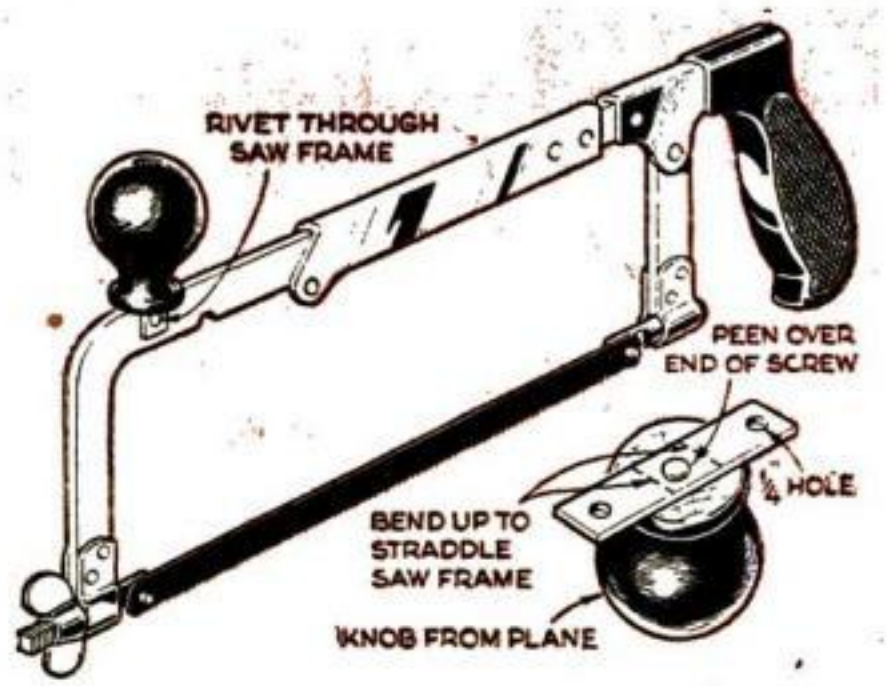


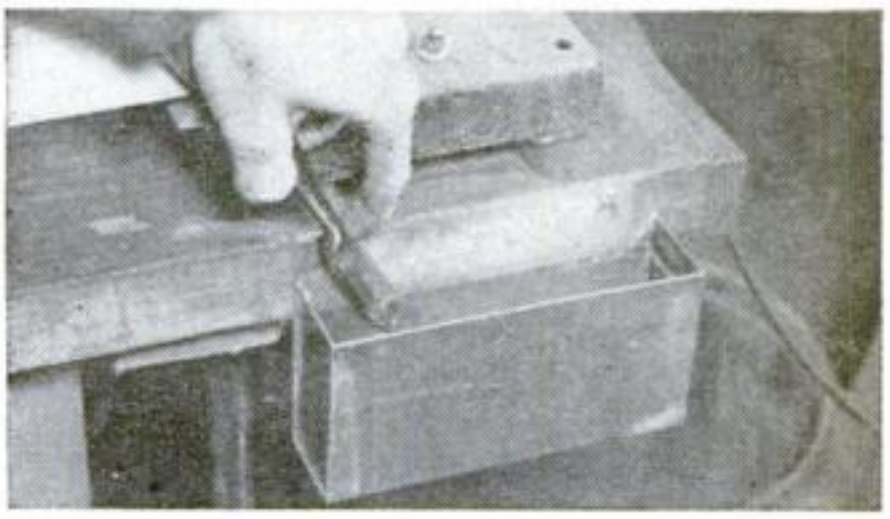
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**THIN METAL DISKS** of various diameters were called for on a job I was doing, but neither a circle cutter without a pilot drill nor a circular hacksaw produced satisfactory results. I found that the method shown at left would turn out disks of brass, copper, or aluminum quickly and easily. A piece of metal was chucked, turned to the diameter of the desired disk, and the end cupped slightly. Then a hardwood dowel of the same diameter, its left end also cupped a little, was centerdrilled to fit a rod held in the tailstock chuck. A small ball bearing between the chuck and the wooden piece permitted a metal blank to be sandwiched as shown under firm pressure. The disks were cut with a lefthand tool set almost touching the wood. Formed by a combination of turning, spinning, and shearing, the disks had little burr.—PARKER E. HART.

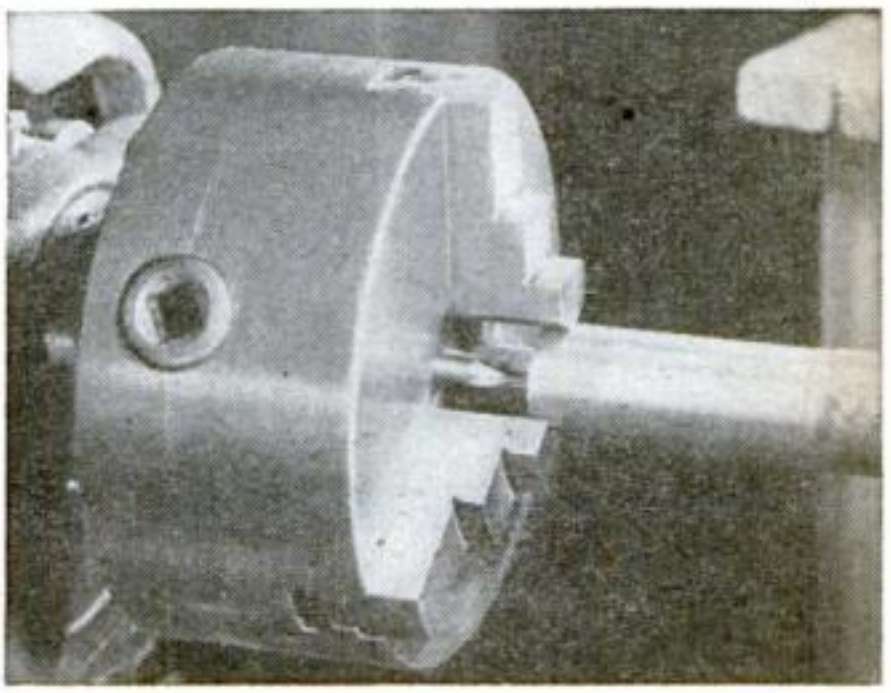
**AN OUTBOARD HANDLE** for a hacksaw, below, taken from an old plane, permits better control and more easily regulated pressure on the work. It also aids in lifting the blade slightly on the return stroke. A thin metal strap and rivet serve to hold the knob to the hacksaw frame.—JOHN KRILL.



**BURNED TOOLS** are all too likely unless you have a water can close by the grinder. The one above, made by soldering two end plates in a discarded brass letter rack, holds a sufficient amount of water, won't rust, and is always conveniently at hand. In the absence of a letter stand, a similar water can might be made by soldering up sheet brass, copper, or galvanized iron. Don't use tin-can stock; it is likely to rust through and leak in a short time.—W. A. C.

**CENTERING ROUND STOCK** may be done in short order with the setup shown at the right. The centerdrill is mounted in a taper shank fitting the headstock spindle, on which a three-jaw chuck is also mounted. Set the drill in its shank so that the chuck jaws project slightly beyond the drill point. The work is placed against the drill and the chuck jaws turned against the work to center it. Leave the jaws just loose enough so that they can revolve around the work, which is kept from turning with the left hand while the right hand feeds in with the tailstock hand wheel. Use a slotted bushing to protect the jaws from wear if much work is to be centerdrilled.—C. W. W.





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# Props Put

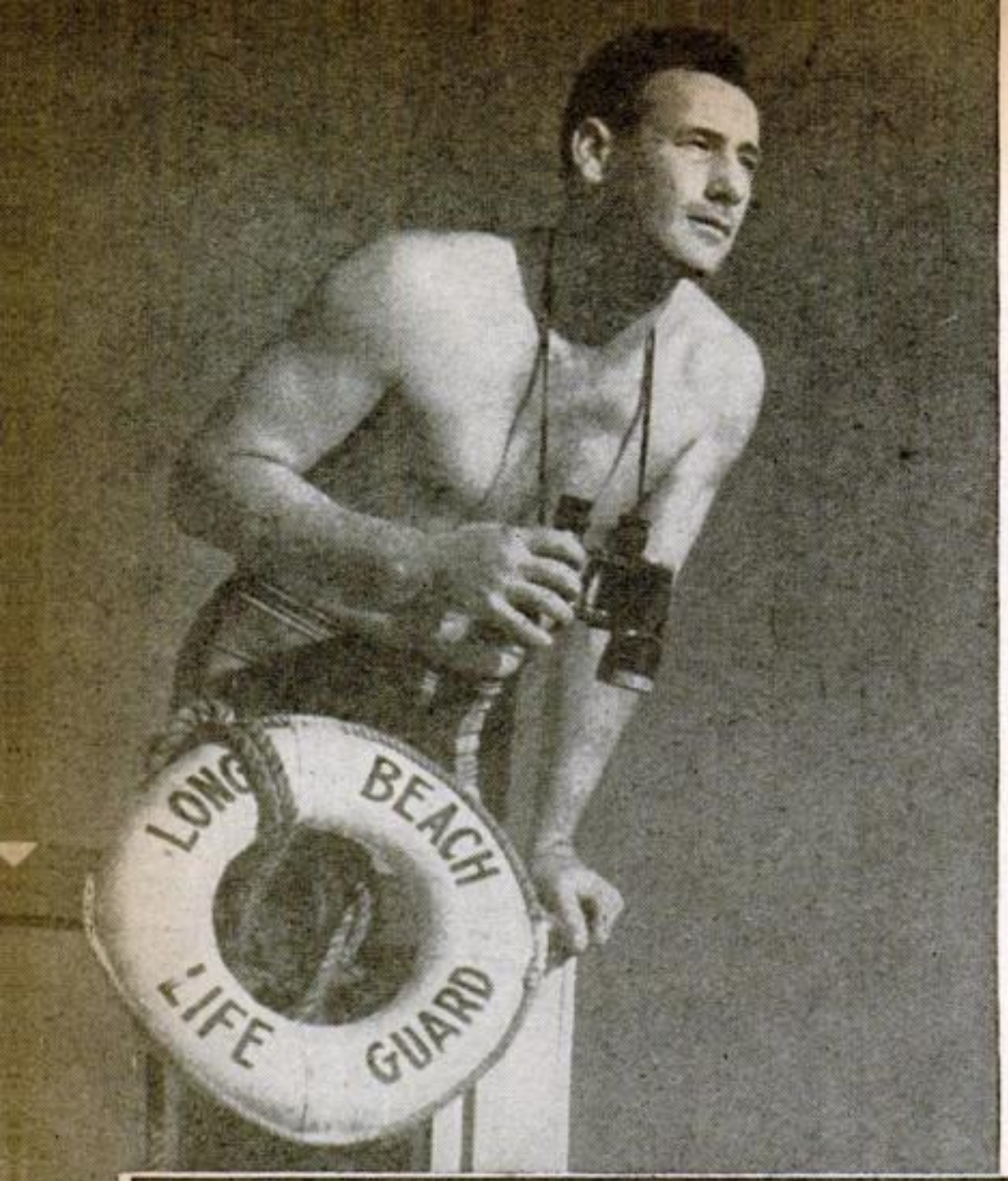
By RICHARD W. EMERY

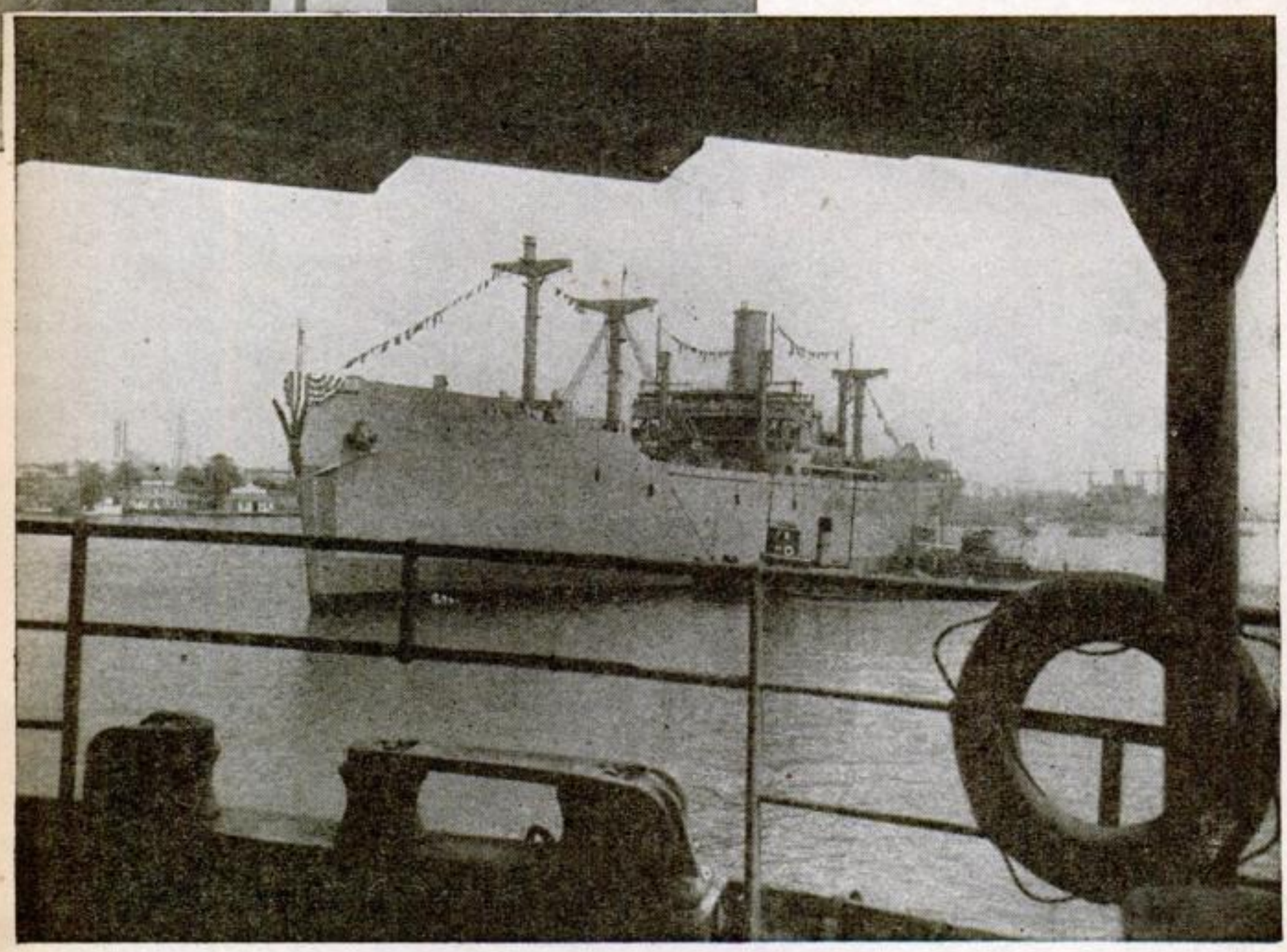
*Photos by RAY CHAPIN*

ON EVERY movie set, there's a property man, called a "prop man" for short. He's there for a reason. Props will do for a picture what spice does for an apple pie. They give flavor and atmosphere—and punch. And props can do as much for your stills, whether they are taken indoors or outdoors.

The use of props in pictures is as old as art itself. Some of the most ancient drawings by prehistoric man found inscribed in stone show hunters shooting bows and arrows. The bows and arrows are props.

If you take a photo of Grandma knitting a shawl, the knitting needles and yarn are props, and



Without a life preserver and binoculars as props, the top photo would be little more than another shot of a bather. Below, a nautical foreground gives atmosphere and good composition to a picture of a ship.



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# Atmosphere into Your Photos

so is her rocking chair. You can, of course, get a picture—and probably a good likeness — of Grandma without the knitting, but the props help to give it life, to put Grandma in a scene in which she characteristically appears. Those who know her best will most appreciate the picture, but the details will help characterize her to others.

Look at the setup before you take your next picture, and the chances are you will see many empty areas in the rectangle enclosed by the camera finder. Don't shoot until you have studied the situation for possible use of props. Maybe a footstool for Grandma's feet would help. A picture of Grandpa on the wall may square up a weak corner. Or it may be that moving the scene to a spot by the fireplace will provide an attractive old-fashioned background and give your photo atmosphere and character.

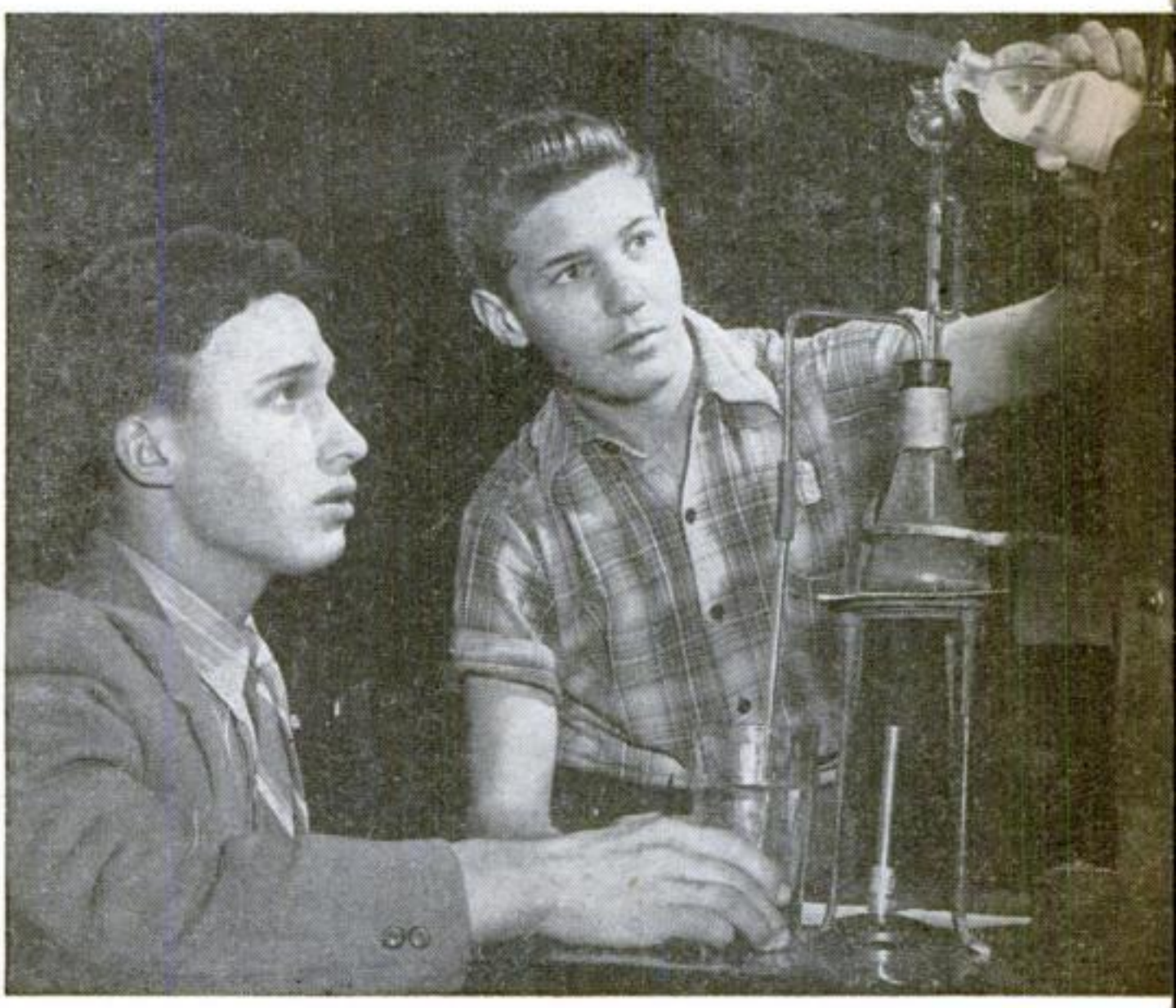


*Photo courtesy of Ford News Bureau*

**Props that help show your subject in characteristic action add interest to a photograph. The chemistry apparatus above does the job effectively.**

Through careful choice of props, you can make your photographs distinctive and different. Props can make a picture amusing or grim, whimsical or realistic. They set the stage for the theme of your photo, and a theme is what gives a photograph its kick. By taking a little time before your shoot, you can place props where they will help tell your story. You can pep up a trite subject and make it fresh and interesting. With a little imagination, you can find props that will help give your photographs a lot of action.

But remember that while props add to a picture, they cannot remove an objectionable background or foreground except by hiding the distracting elements. So before loading your setup with props, view the location with a critical eye, and choose a spot that helps express the theme and does not contain distracting elements that cannot be cut out or hidden.

Use props that harmonize with the central interest of your picture and remove those that don't. To cite an obvious example, if you are making a picture of a garage mechanic probing into the motor of a car, you would use such natural props as wrenches, hammers, and spark plugs.

Be logical. The setting for your picture, props and all, must be plausible. But you will be surprised how many props you can stuff in without making the finished picture look cluttered or overdressed.

Use props that will enable your subject or subjects to be doing something. Such action adds interest to the picture and helps put the subject at ease. Square up your picture with allied objects. If it is to show Aunt Effie in her rose garden, take her in the act of planting a new rose bush, give her a trowel to be using, and square up the corners with such things as a wheelbarrow, watering can, hoe, and rake.

Small props add interest to close-ups. One of a farmer, for instance, may be shot against a good rural background with a haystack, parts of a cornfield, or cattle showing, but watch for the little props. If it's in character, you may have the farmer chewing a straw, biting a chew off a plug



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Pretty girls and handsome horses make good pictures anywhere, but here a real Western interest has been added simply by inclusion of a weather-beaten gate.

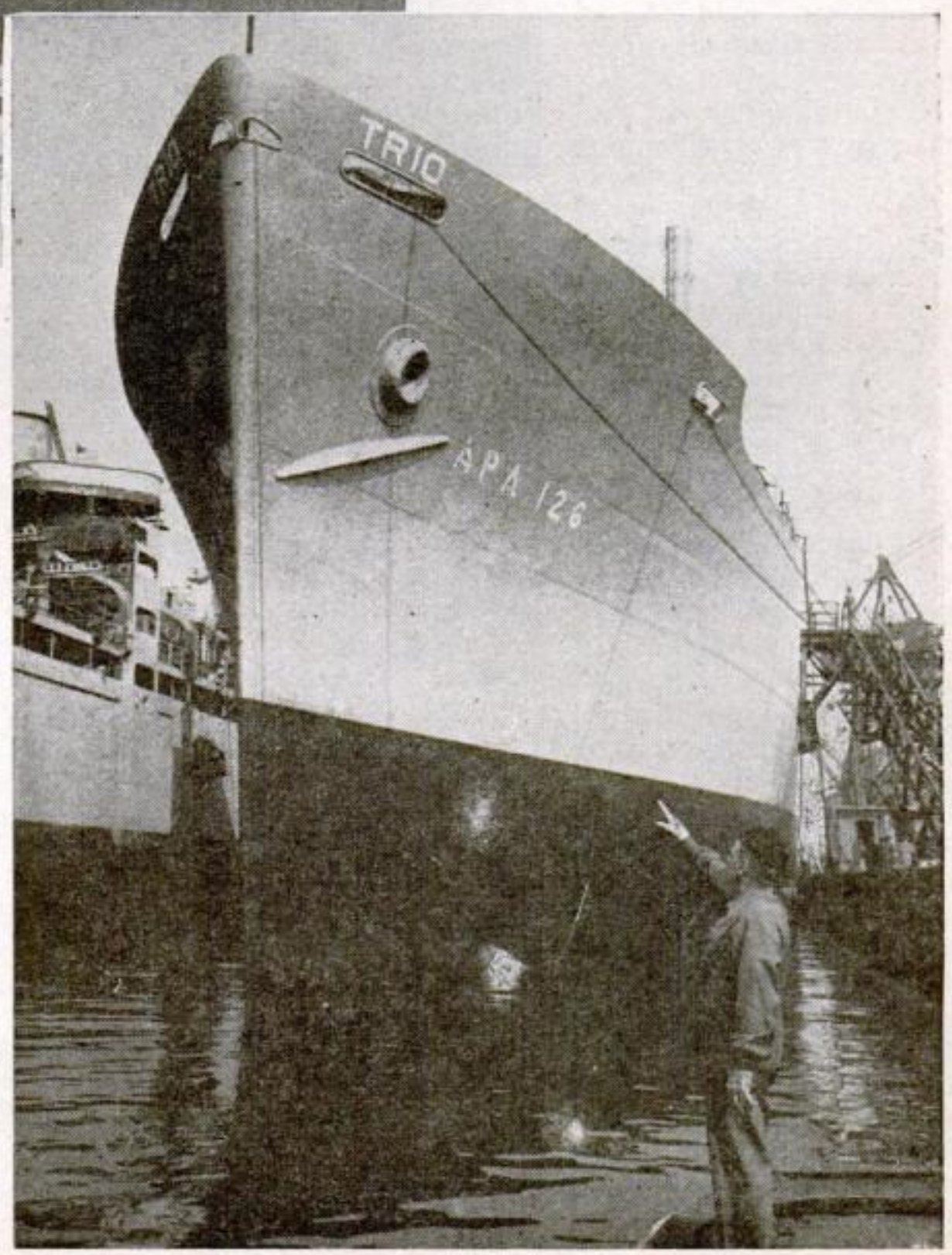
People as well as things can sometimes be employed as props. That's the purpose of the person in the foreground in the photo at right. He adds interest and gives size comparison.

of tobacco, or intent on sharpening an ax. Watch for such little things as overall buckles, a straw hat or bandanna handkerchief, work gloves, or boots. But be sure to keep them in character with your subject.

Under certain conditions, people themselves can be used as the props. Most scenic photos gain when one or more persons can be seen somewhere in the picture.

You can use props to give size comparisons to subjects that alone might be deceiving. For example, a photo of a fish lying on a platter gives little clue to the size of the fish. It might be a small one on a small platter or a large one on a large platter. But a knife and fork in the picture will give a comparison.

One prop out of many may be accented for a second central interest. In a photo of Uncle Bill comfortably seated in his






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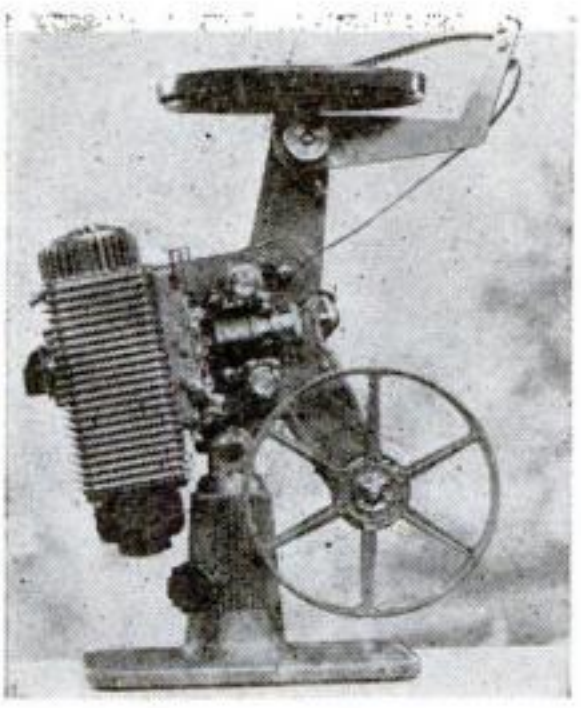
**How big were the fish you caught? A rod, hat, and knapsack give a fair comparison here beyond dispute.**

favorite chair and oiling his trusty shotgun, the oilcan poised over the breech can be accented. The other props will be unaccented, but they will add atmosphere and interest.

Although the average picture can stand lots of props, their use can be overdone. Too many, especially too many prominent props, can overbalance the subject, which, after all, is the central interest. If a prop jumps out at you as you scan the setup through the finder, discard it. And in its place get one that won't steal the show.

There can be no book of rules on the use of props, for each particular picture calls for its own treatment. But, as already explained, there are many do's and don'ts. You are the doctor who must determine, for each individual case, how the props are to be employed most effectively, and what you do may make or break your photos.

## NEW PHOTO EQUIPMENT



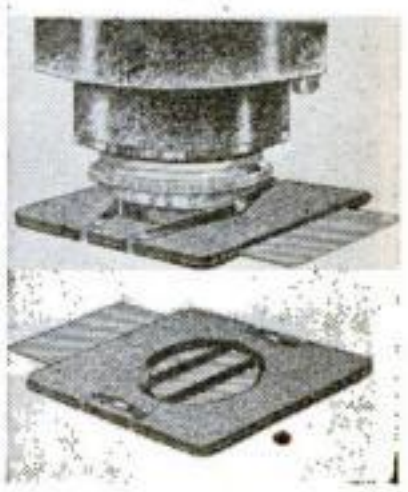
**REWINDING OF MOVIE FILM** once it has been shown becomes unnecessary when a new type of reel is used. Put on the market by the Motion Picture Equipment Company, of New York City, this nonrewinding reel set may be used with all types of movie projectors, either amateur or commercial. It consists of two identical reels with an attachment that will fit all 8- and 16-mm. silent and sound projectors, the film feeding from either the center or edge of the top reel.

In addition to the timesaving feature, the manufacturer claims that the set prevents wear on the film because there is no friction that could cause damage to the emulsion surface. The two reels in the set may be used in splicing, cleaning, and other operations in the same way as ordinary ones. Miguel Lopez-Henriquez, of the Motion Picture Equipment Company, invented the device.



**READINGS** are direct on this new shockproof exposure meter designed for indicating the correct diaphragm opening without calculations. The meter is set for both the desired shutter speed and the film used, and the pointer designates the *f* stop on an easy-reading scale. Over-all measurements are ⅞" by 2¾" by 3⅜" and the weight is 6 oz. The Hickok Electrical Instrument Company, of Cleveland, is the manufacturer of the handy little accessory.

**CONTROLLED DIFFUSION** in making enlargements is possible with a diffuser developed by the Spencer Company, of Mt. Vernon, N. Y. The degree of diffusion, to obtain desired effects, is varied by the amount the enlarger lens is covered by a diagonally lined transparent screen. This slides in a frame attached to the lens by means of a strong rubber band. In use the diffuser is attached to the enlarging lens after the negative is in place and the unit focused sharply, and it is then adjusted.





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# CAN YOU BEAT THESE PICTURES?

*We will pay $5 for any photo used on this page. Write your name and address on each print. Enclose a stamped, self-addressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.*

**TRICK ROOM?** Well, maybe. The photo below was taken after an explosion in a candy firm's plant in Buffalo, N.Y. Chairs did a loop and landed on the ceiling, where they stuck in almost the same position they had occupied on the floor.





"A stitch in time saves nine."

**PHOTO CHARADE.** This little lady is occupied with a task that forms the basis for an everyday expression. Do you know what that expression is? If you turn the page upside down and look closely at the fine print, you'll get it.

**TARGET SHOOTS AT B-17.** Tracer bullets are being blasted from .50-cal. guns in the turrets of the Flying Fortress shown below. The camera clicked just as one of the tracers hit a hard place in the revetment and ricocheted in a wide arc back over the big plane. Vernon T. Manion, of Seattle, was behind the camera.



**DON'T GET DIZZY** as you look at the photo at left. But it's safer to suffer from vertigo while looking at the picture than it would have been for J. V. D. Saunders, of Clarksville, Tenn., when he made the shot. It's a view down a stair well from the fifth floor, and shows four different turns in the stairs down to the first floor.

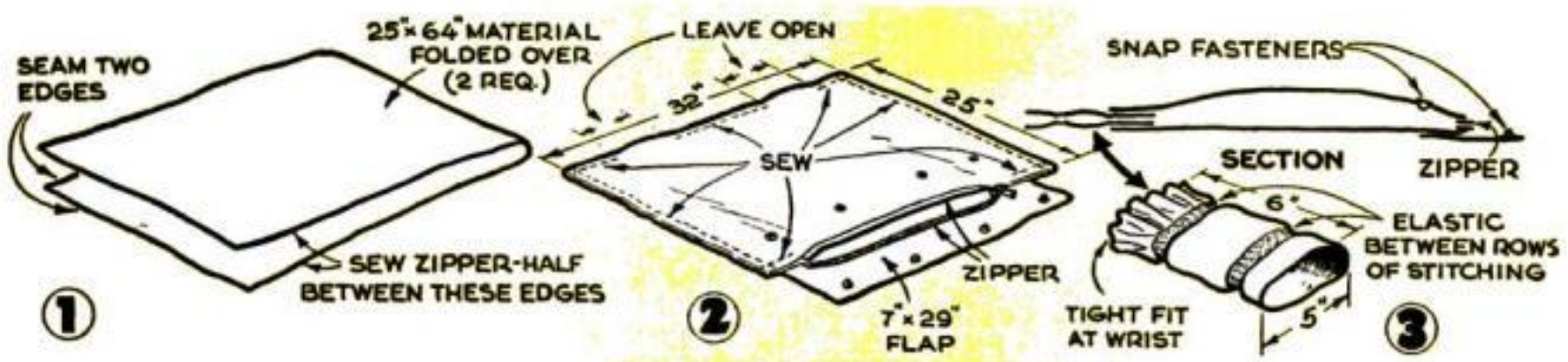




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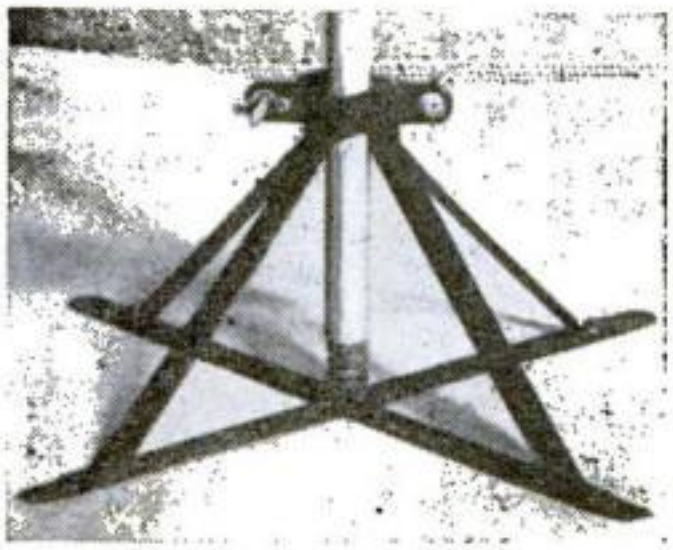


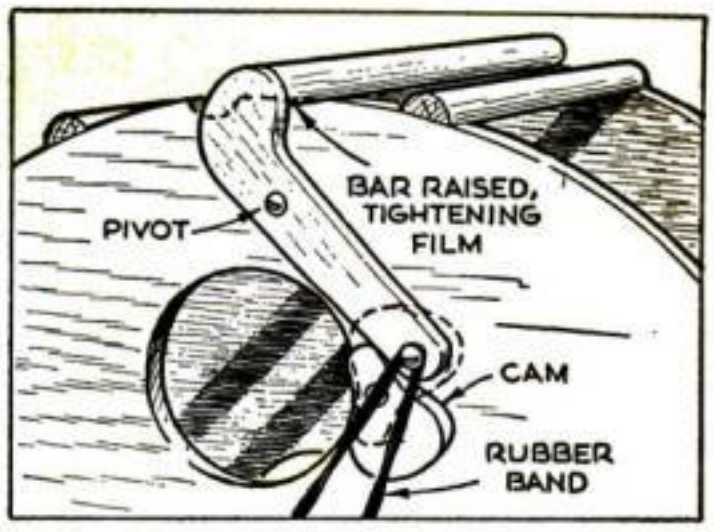




**CHANGING BAGS** are a convenience both at home and afield. They can be used at home for loading film into a developing tank and either at home or on photographic jaunts for loading cut-film holders. The bag above was made from a double thickness of black sateen, about 4 yd. of material being required. Make two sides, each of double thickness, as indicated in Fig. 1, seaming two of the open edges and sewing half of a zipper in the remaining open side. After the two halves are complete, sew them together as in Fig. 2, leaving two open spaces on the edge opposite the zipper for wristlets. Make the wristlets of a double thickness of sateen and stitch two elastics into each. Sew a flap to the zipper edge and attach snap fasteners as shown in Fig. 3.—F. C. SMITH.



**STANDS** to hold clamp-on reflectors can be devised in many ways, but one of the simplest consists of a broomstick or other piece of wood thrust into a metal Christmas-tree holder. A stand of this sort can be quickly rigged up, is light, and requires little storage space.—F. C. S.

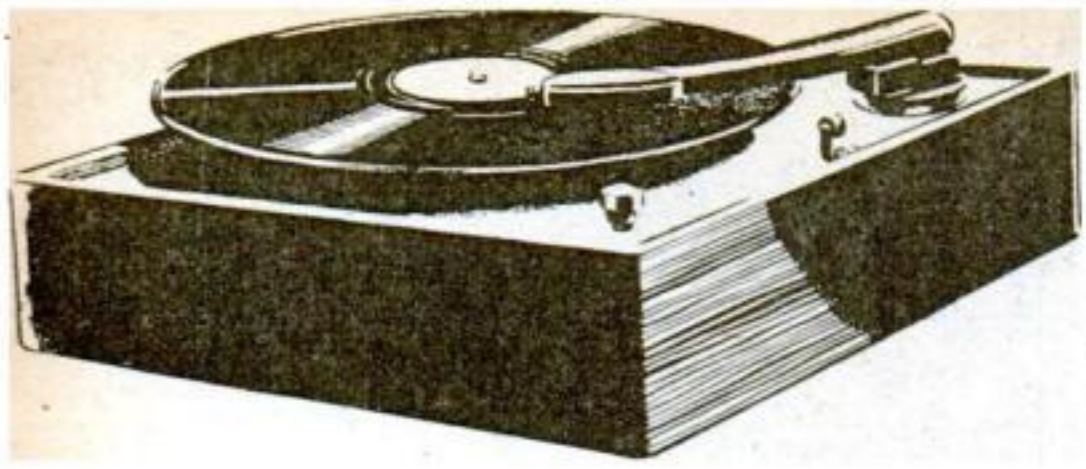





**MOVIE FILM** is sometimes damaged if it stretches and loosens on a developing drum. Consequently, I removed a slat from my drum and replaced it with one that lifts, as above, to keep the film tight at all times. An elastic band provides tension when the cam is swung downward.—SIDNEY POTT.



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# Improving

## SMALL THINGS CAN MAKE

By Tracy Diers

OWNERS of inexpensive record players often content themselves with lower standards of performance than they would like because of the belief that price and quality have to go hand in hand. Generally speaking, that's a sound rule, but it doesn't mean that the performance of such phonographs can't be improved.

Defects inherent in many players can be corrected at least in part. Among the most common faults are A. C. hum, motor vibrations, "wows," and distortion of high-volume passages.

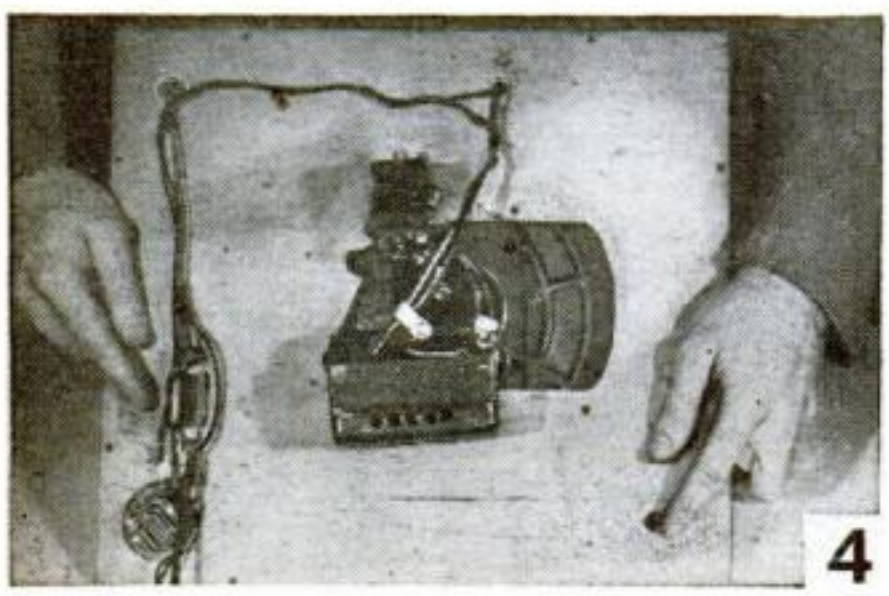
While this article deals only with adjustments that can be made in the record player, a few things should be known about the amplifier with which it is used—in most cases the output stage of a home radio. Most important, of course, is the question of whether it is the radio that is causing the disturbing background hum. If your radio doesn't have a separate ground lead, it is probably of the voltage-doubler type and should not be grounded. In most cases, however, an amplifier or radio will be used that has a ground connection, and this should be securely connected

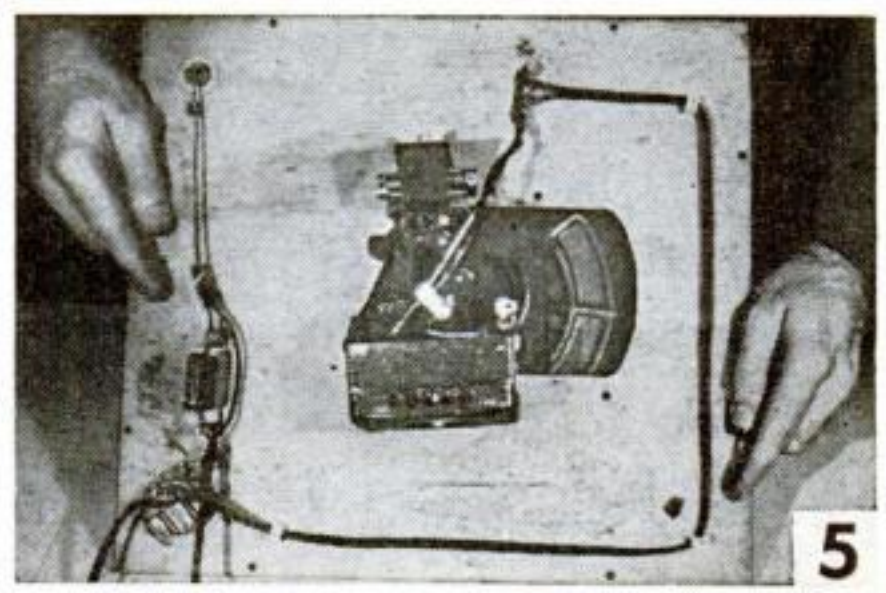



Before attempting to eliminate background hum from the record player, be sure that the trouble doesn't originate in the radio amplifier. A 100,000-ohm resistance will simulate the pickup impedance.

Good grounding is important to humless reception. If an ohmmeter test of the pickup case shows an imperfect ground, solder one end of a piece of wire to the holding nut, the other to the cable shield.

Hum may be caused by the A.C. field put out by the motor line cord. Separate it from the pickup cable.






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# Low-Cost Record Players

## A BIG DIFFERENCE IN THE QUALITY OF YOUR PHONOGRAPH

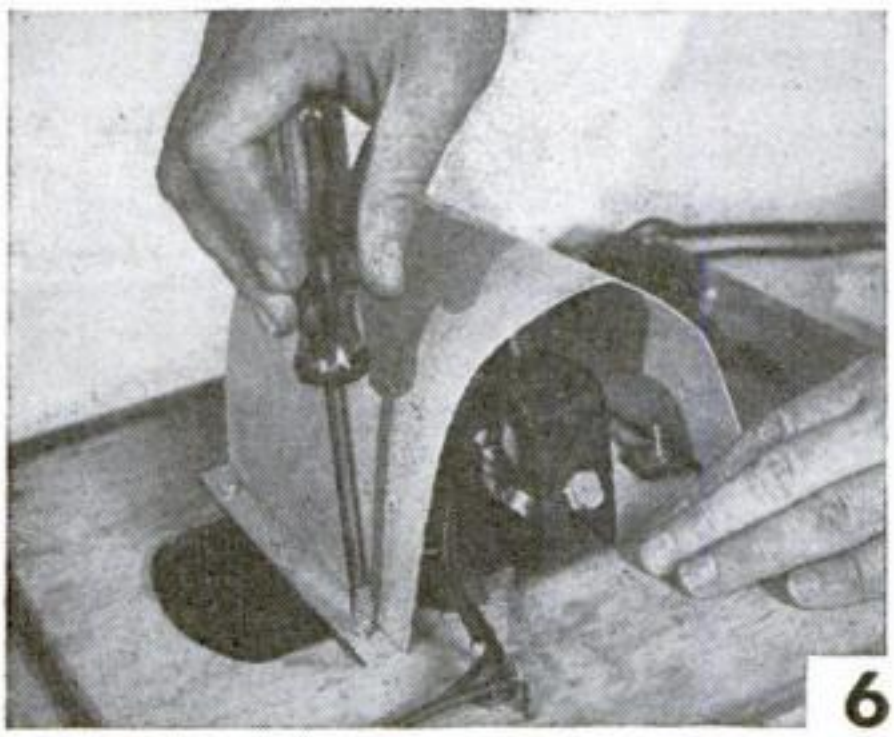
to a water pipe, steam radiator, or the like.

Remove the phonograph plug and replace it with a 100,000-ohm resistor to serve as a dummy load. Turn the volume up to the usual point and note the hum level. If it is very pronounced, then you must seek the trouble in your radio; if not, remove the resistor and reconnect the record player. With the motor turned off, but the volume up to its customary level, listen again for hum. Whatever increase you now hear may be put down to the record player. The trouble may be of either inductive or mechanical origin.

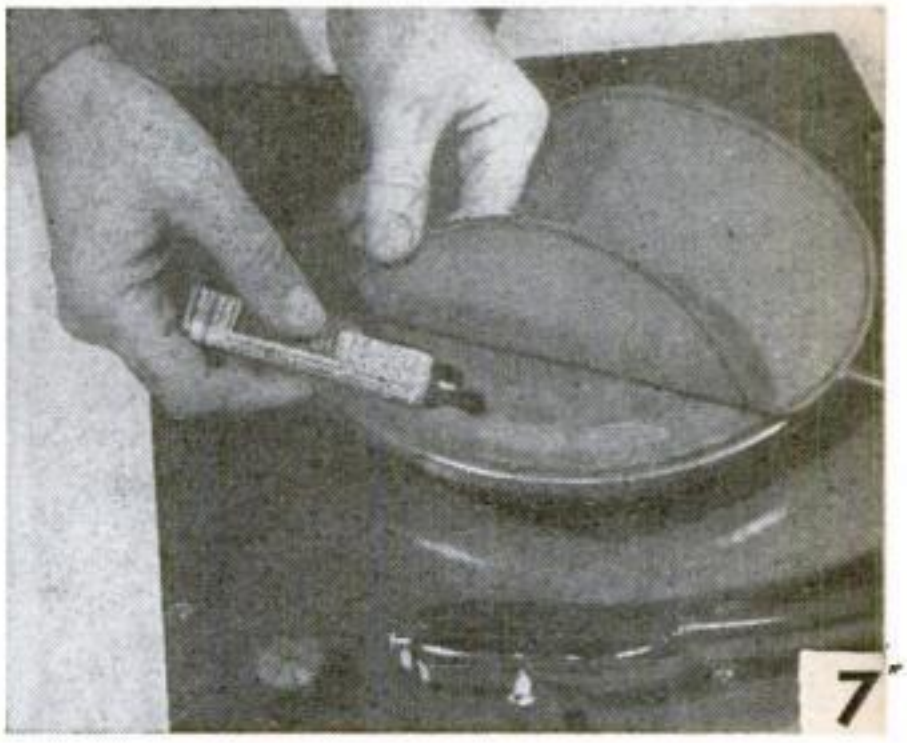
Connections between pickup and amplifier are one source of induced hum. If ordinary wire was used, replace it with shielded cable and ground the shield. To make sure that the pickup case is effectively grounded, touch one prod of an ohmmeter to the ground pipe and the other side to the pickup case (Fig. 2). A perfect ground will give a meter reading close to zero ohms; if it is higher, ground the case as shown in Fig. 3.

Now listen again for hum in the speaker, first with the motor off. As you turn it on, you should hear a click in the speaker, but no hum. If you do hear hum, reverse the line-cord plug.

Still no improvement? Perhaps the motor is putting out an A.C. field that is being picked up by the shielded cable. A motor line cord that runs parallel to the pickup cable (Fig. 4), should be separated as shown



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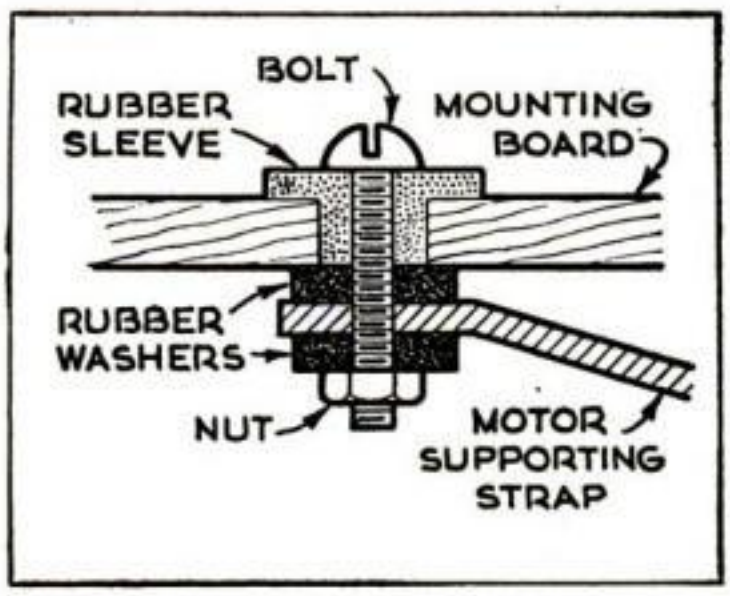


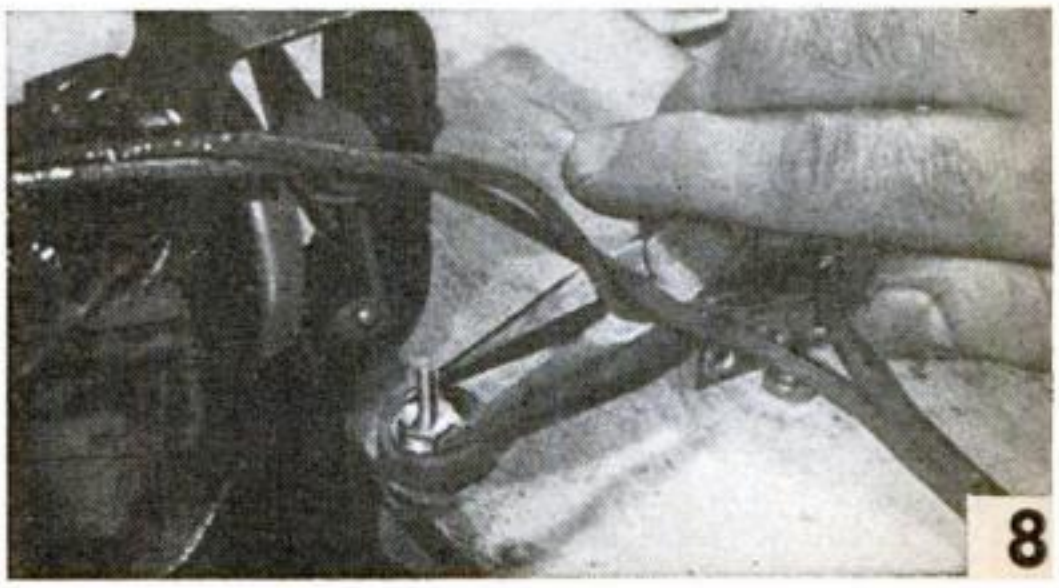
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Sometimes the magnetic field set up by the motor persists even with all leads properly grounded. Should this happen, shield the motor with a thin sheet of any magnetic metal and ground the shield.

To eliminate mechanically caused hum, vibrations transmitted from the motor to the record must be damped somewhere along the line of travel. A piece of heavy felt glued to the turntable may help.

Used with the bolts that hold the motor to the mounting board, rubber sleeves will absorb some vibration.

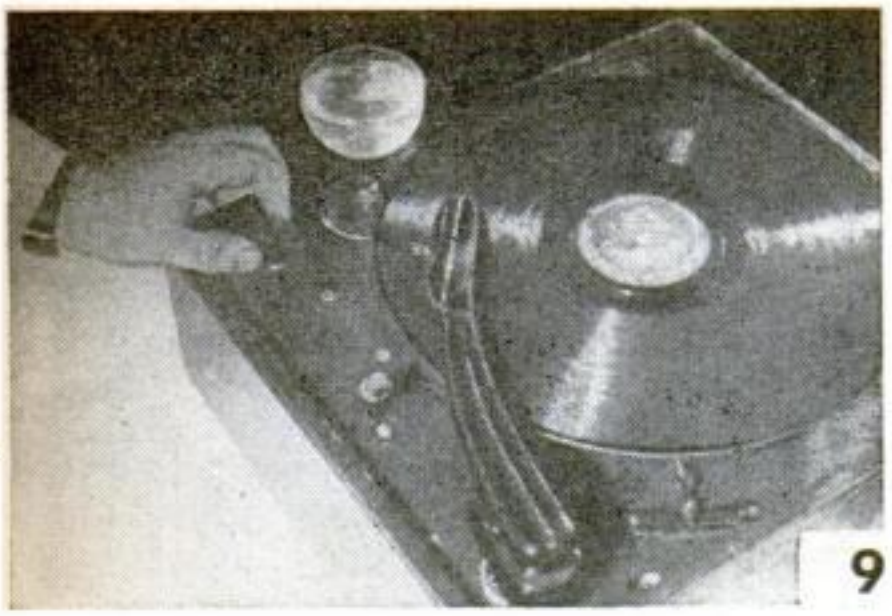


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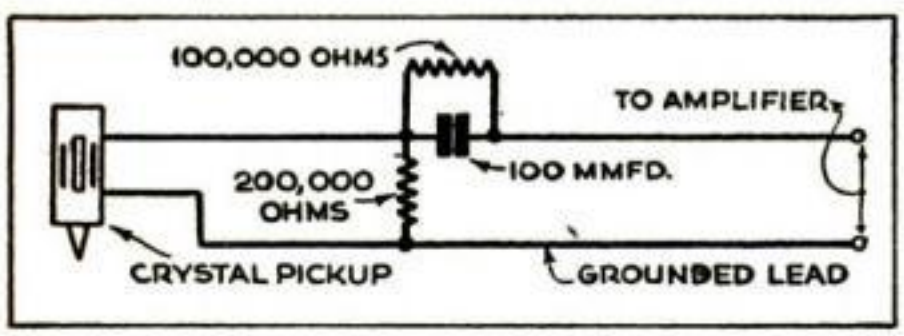
The water test, above, shows if motor vibrations are still being transmitted to the pickup. One common cause of "wows" is fluctuation in the line voltage. A voltmeter across the line (right) will show a dip or rise at the time the music quavers.

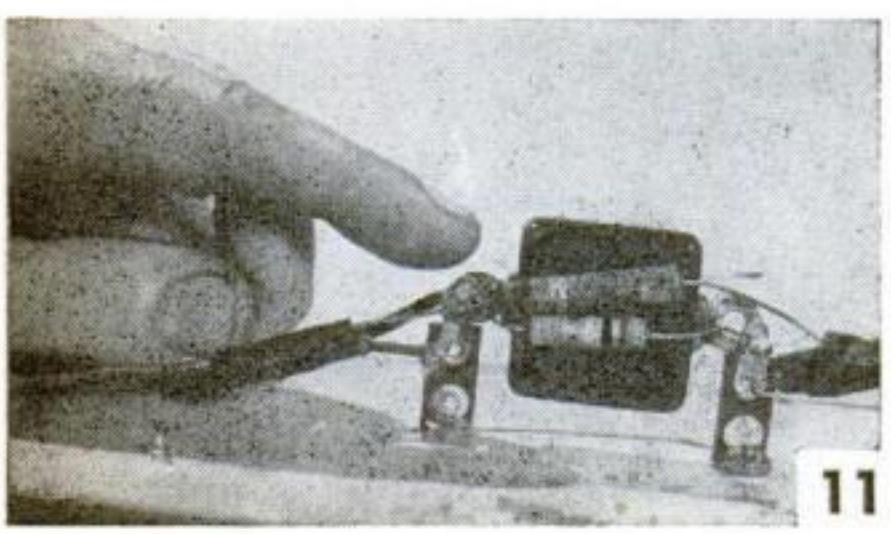
in Fig. 5. Better still, replace the line cord with a shielded two-conductor cable, and ground the shield.

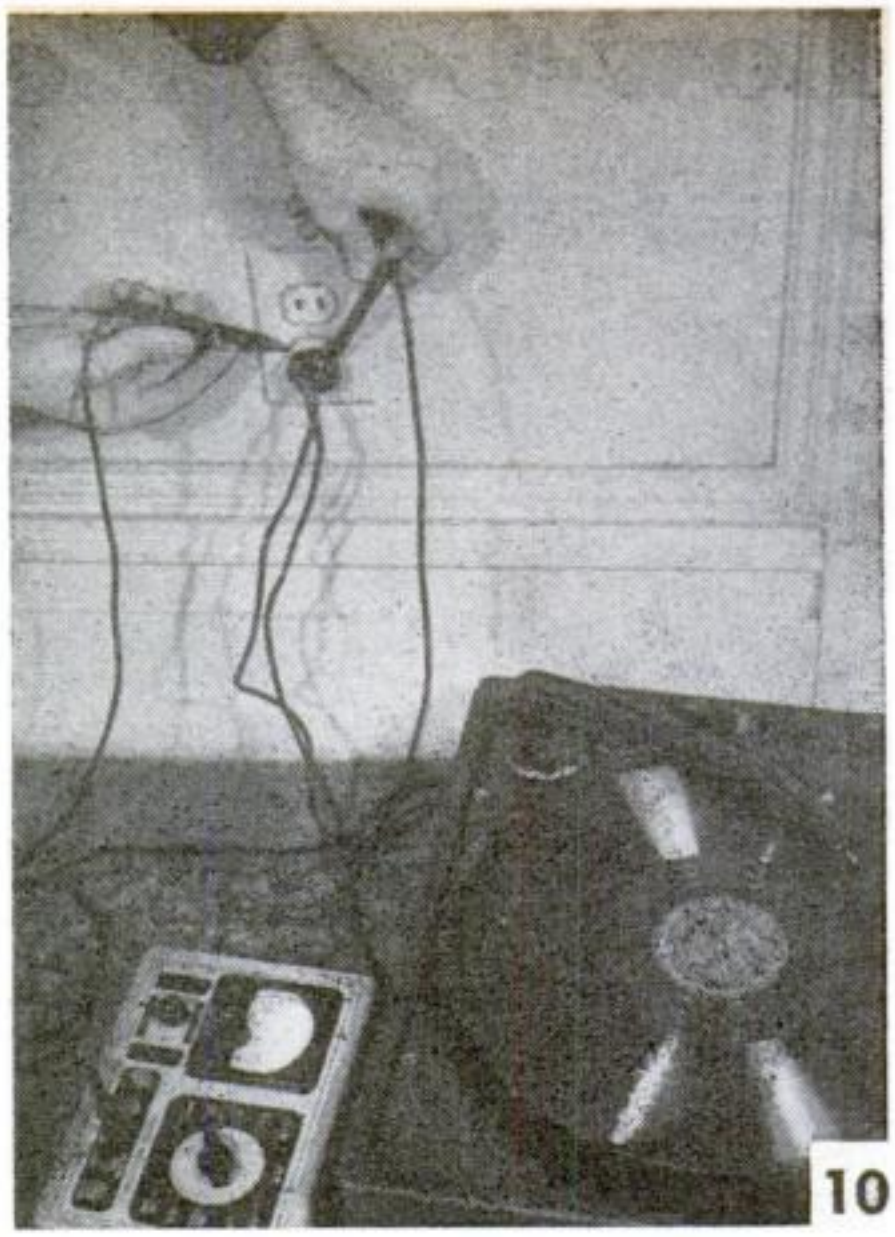
Despite all these precautions, induced hum may still continue to ride through. One measure that still remains is to bend a sheet of iron or similar magnetic material around the motor as shown in Fig. 6.

There seems to be a perverse force in life that always manages to put the thing we're looking for at the bottom of the pile. So don't be too surprised if none of these improvements quite turns the trick. There's a pretty good chance that the trouble is not inductive at all, but mechanical.

Mechanically caused hum usually originates within the laminations of the motor itself, and works upward through the shaft to the spindle and turntable. Once in a while it is possible to eliminate the trouble by tightening the laminations. More often, it





will require that the record be physically isolated from the vibrating motor and shaft.

Cement a piece of heavy felt over the turntable (Fig. 7), and place on it a record having a quiet or unmodulated section. With the needle in the quiet grooves, turn the gain up high. Any hum that can now be heard in addition to needle scratch may indicate that vibrations are being transmitted. Replacing the metal spindle with a rubber one should lessen this distortion. If it doesn't, you will have to sound-insulate the motor from the mounting board.

Use live-rubber sleeves and washers for the sound insulation. Discard old hardened washers, if any, and insert sleeves of at least ½" o.d. (Fig. 8). Do not draw the nuts so tight as to cancel the springiness of the rubber. To test for motor vibrations, use a glass of water as shown in Fig. 9; with the motor running, no ripples should appear on the surface.

Another common trouble found in inexpensive players is a malady known as "wows," caused when the turntable speed changes and introduces unpleasant quavers into sustained musical notes. Rooting out this defect completely might require a major rebuilding job, but the nuisance can be minimized if it happens to be caused by overloading of the line. Using the record player on a circuit on which you already have a refrigerator, oil burner, or other fair-sized load may mean that the player is subjected



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to voltage fluctuations introduced into the line when this equipment is turned on and off by regular service demands.

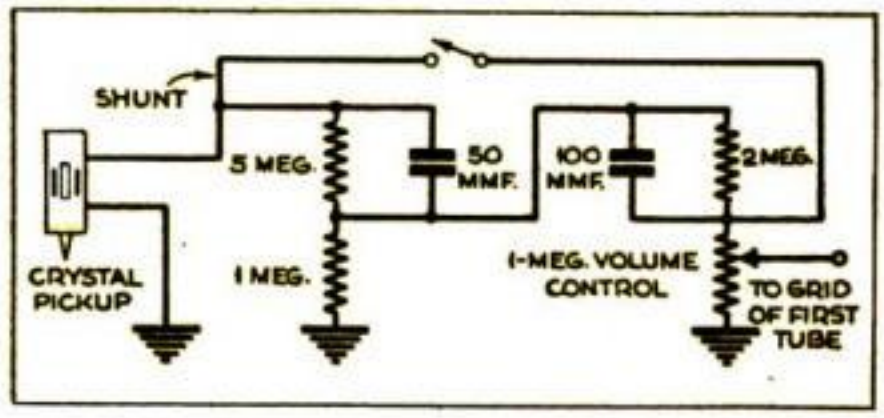
To check line fluctuations, connect a voltmeter across the record-player plug at the point where it enters the wall receptacle (Fig. 10). At the instant a "wow" occurs, the voltage may show a marked variation. Should this happen, try the record player on a less heavily loaded circuit.

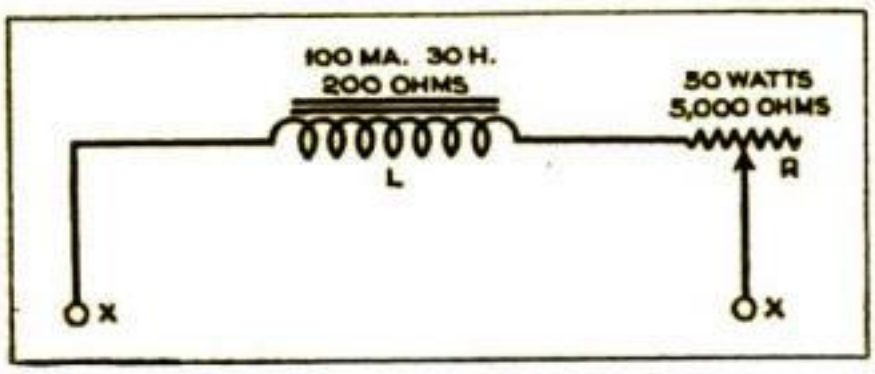
Distortion of high-frequency sound passages results when a crystal pickup generates too high a voltage for the amplifier with which it is used. This defect, known as "blasting," can be remedied by the simple filter circuit shown with Fig. 11.

## Filter Increases Tonal Range of High-Fidelity Crystal Pickups

SOME of the newer phonographs feature pickups with excellent crystals and extremely light needle pressure. Used in conjunction with the vinylite-type records that practically eliminate needle scratch, it is possible to get the full tonal range actually recorded on the disks.

But because recordings are made with magnetic cutters and played back with crystal, a filter should be inserted in the pickup circuit to compensate for inherent differences in frequency characteristics between magnetic and crystal devices. The shunt is used to disconnect the filter when old-style records—still the most common—are being played.—JOHN W. CAMPBELL, JR.



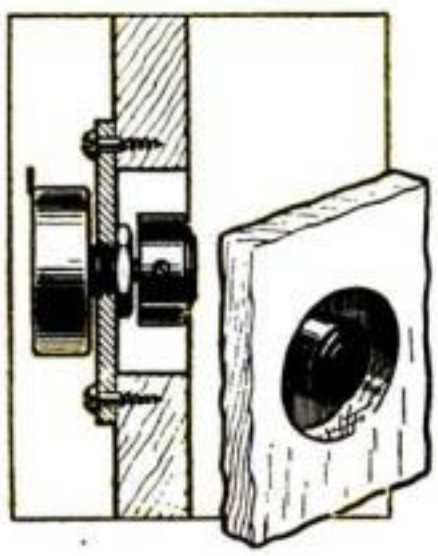




## Test Gives Field-Coil Resistance

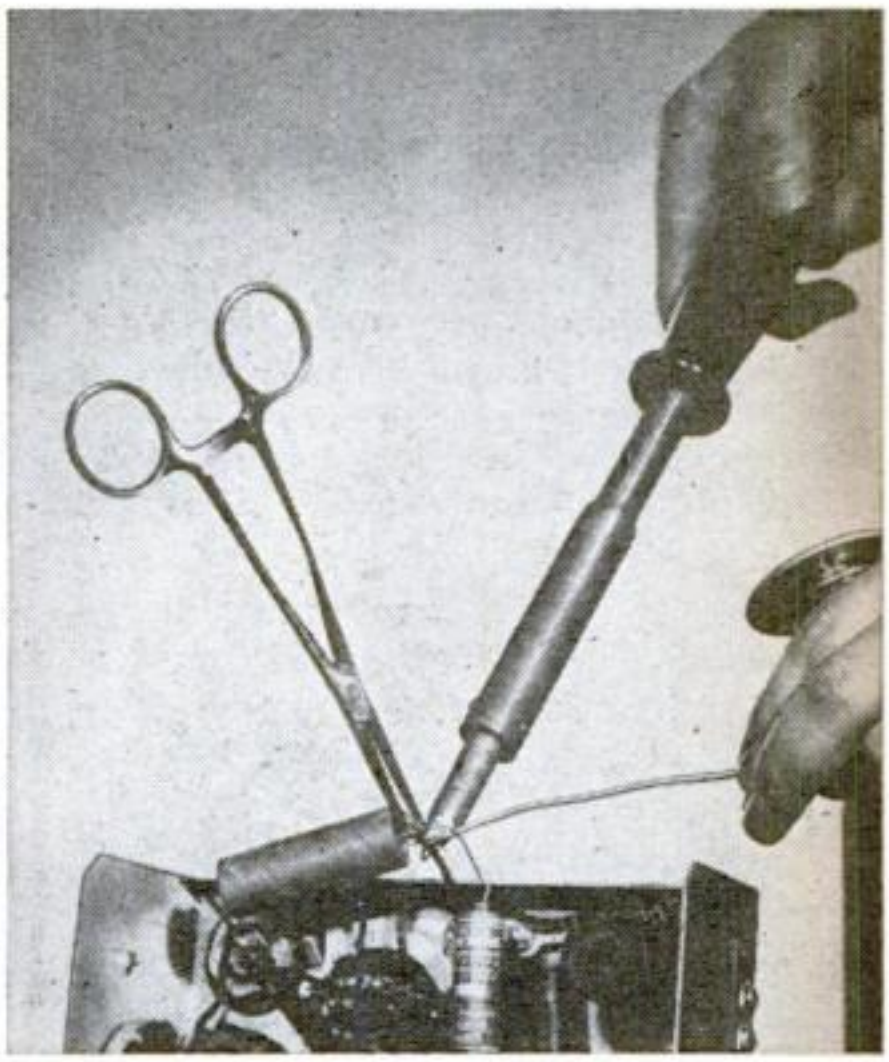
WHEN the resistance of a burned-out loudspeaker field coil is not marked on the original—as often happens—finding a replacement poses a problem for the serviceman. Connect a resistance in series with coil L, as shown above, across the field-coil terminals, and vary R until proper plate and screen voltages are observed. Turn off the power, and measure resistance $x$-$x$. Install a coil with the same value.—JACK KING.

## Knobs Protected by Recessing

FLUSH knobs on a portable radio or phonograph case can be fitted by cutting suitably sized holes in a thick panel and mounting the controls on composition-board sheets screwed on behind. Knobs in this position cannot interfere with the closing of tight-fitting covers.—G. O. S.



## Surgical Instrument Serves as "Third Hand" for Serviceman

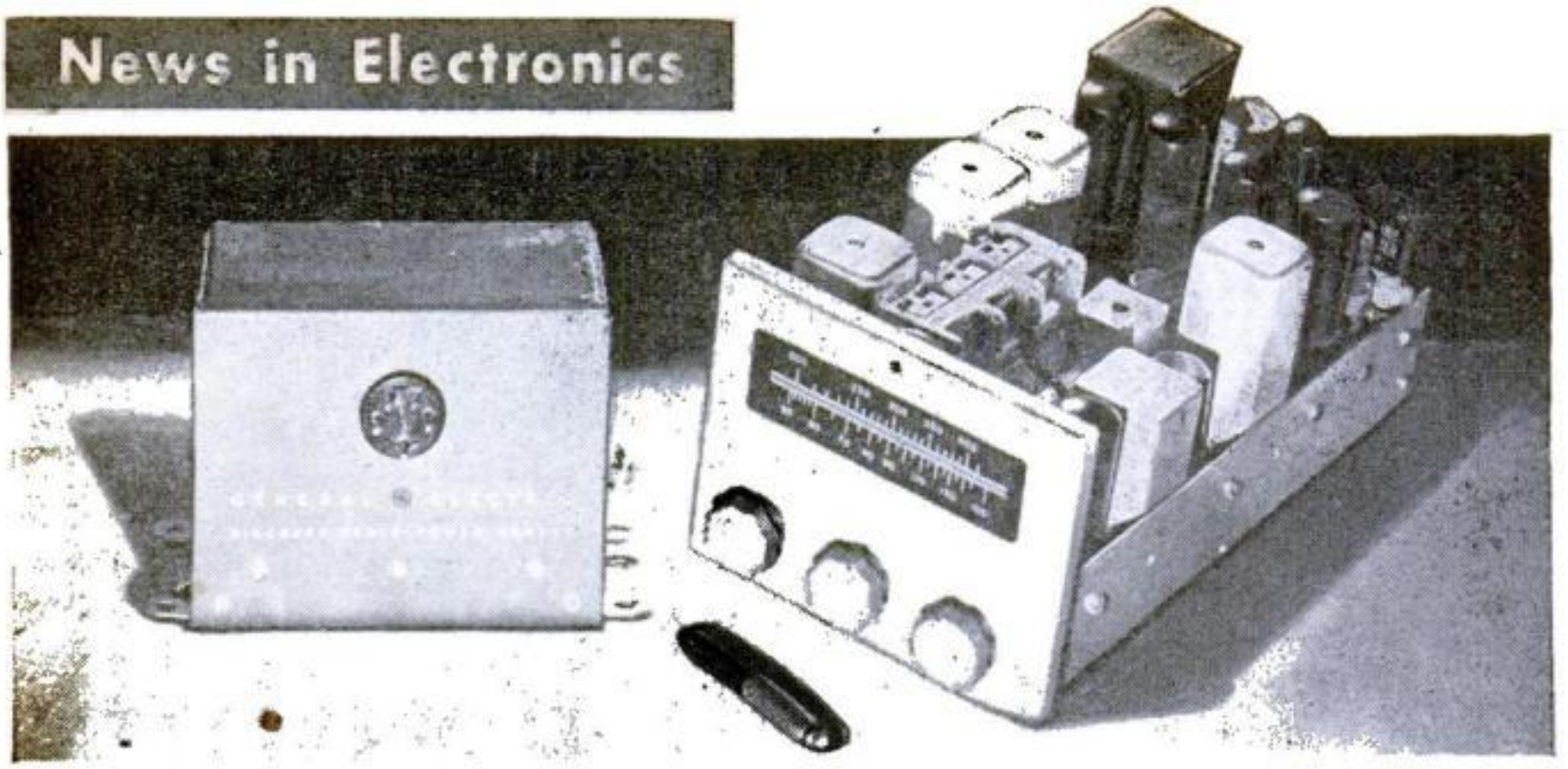


TEMPERED steel forceps that can be made to lock in one of several positions are particularly useful for holding wires or small parts in place while both hands are used for soldering. Slightly damaged or worn hemostatic forceps of the type illustrated above are available at many secondhand stores. Metal shims may be soldered to the blades to allow the right pressure for frequently repeated operations.—H. LEEPER.



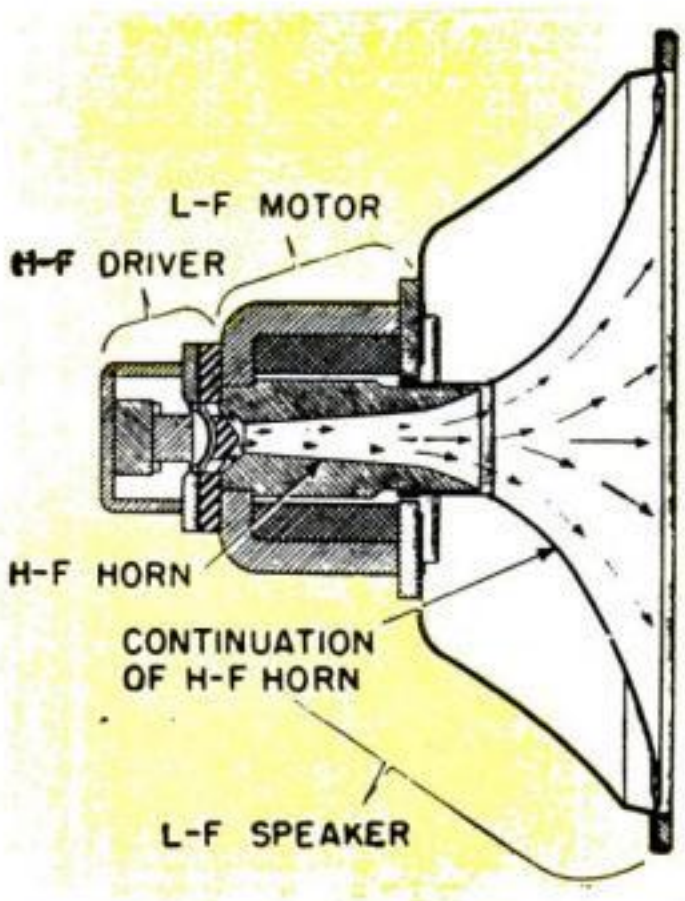
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# News in Electronics

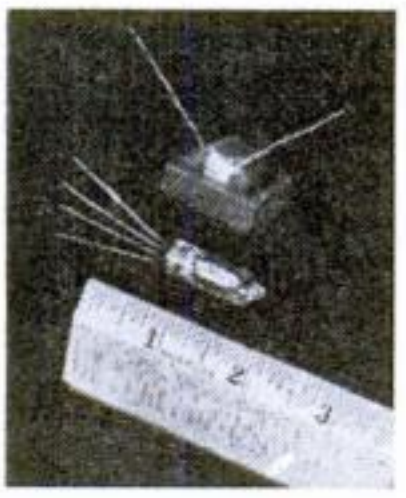


**PERSONAL PLANE RADIOS** are now being readied for purchasers of private planes. Illustrated above is a receiver-transmitter made by General Electric for communication with tower and radio-range stations, and designed to operate directly from a 12-volt airplane battery. Similar instruments of both receiver and transceiver type have been announced by other manufacturers, including Bendix, Lear, Macguire, and Ranger. All of them feature compactness and low battery drain.

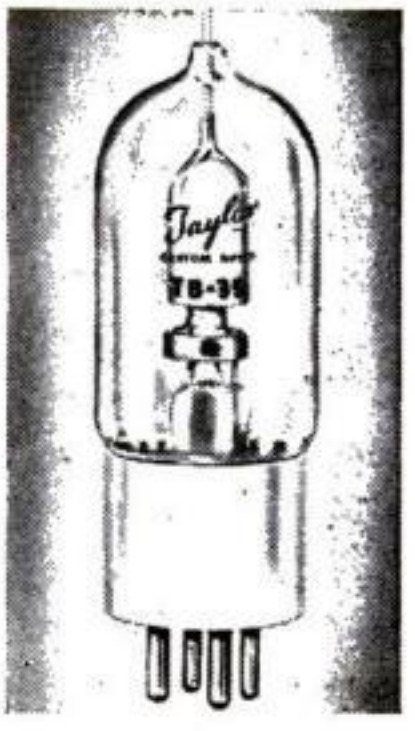
**FULL FREQUENCY RESPONSE** formerly required the use of two speakers, one specially adapted to reproducing the low notes, and the other the highs. These two functions are now performed by a single unit of the type shown below. Called the Coaxial speaker, and made by the Jensen Radio Manufacturing Co., of Chicago, this instrument is designed to give better control of the objectionable resonances in the "crossover region" where both speakers are operating. It also equalizes sound radiation.




**MATCHING** the almost microscopic size of hearing-aid tubes, this choke coil has a regular laminated core, and is assembled in the same way as the larger, more familiar type used in radio receivers. Low power requirements of the minute tubes permit the design of tiny but efficient components. Originally made on special order only, chokes of this size are becoming generally available.



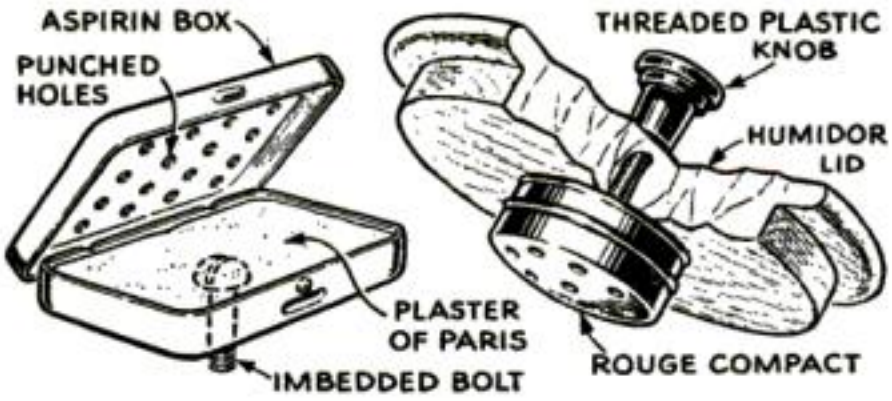
**VHF AND UHF** operation, being relatively new and unexplored, has been hampered by a shortage of standard equipment. Filling in one gap is the TB-35 beam tetrode shown at the right. It is made by Taylor Tubes, Inc., of Chicago, and is designed to deliver 130 watts of output power at 250 mc. and about half as much when operated up to 400 mc.



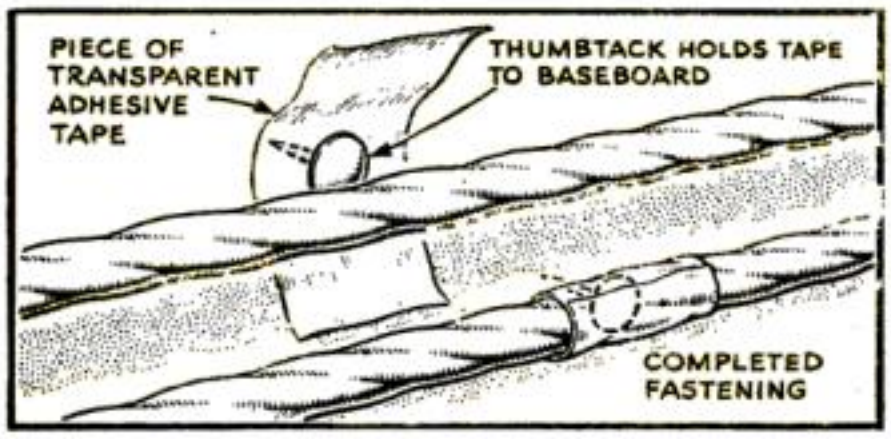



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## Plaster Keeps Tobacco Moist

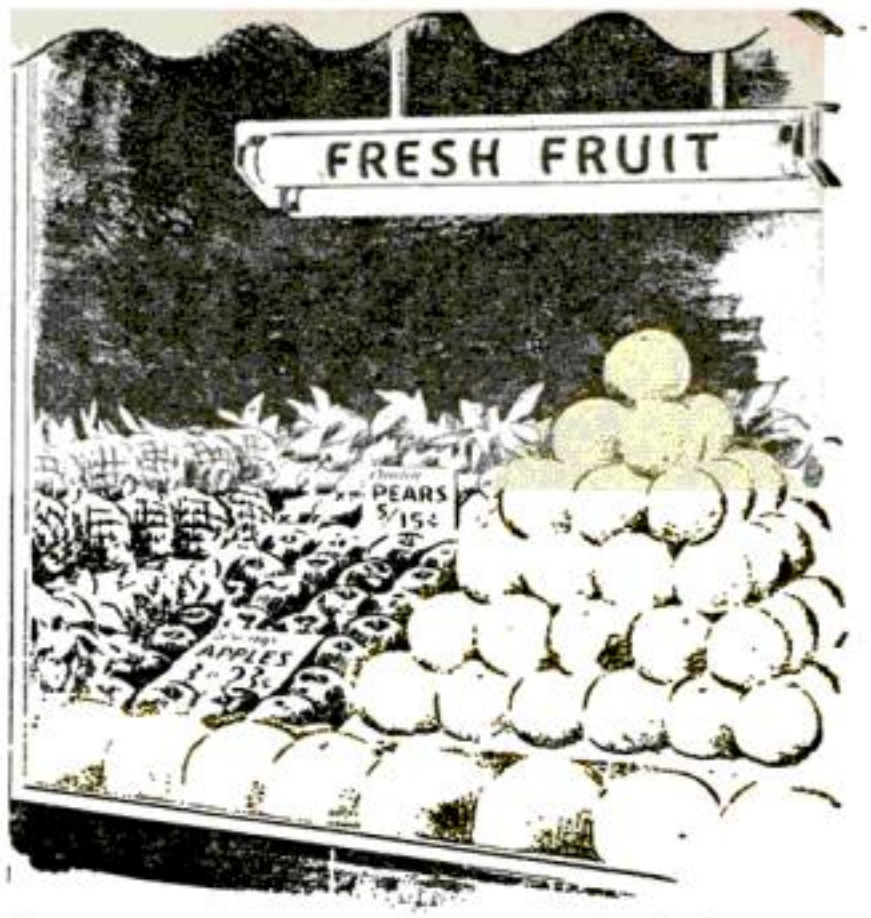



ANY small plastic or metal container can be used as a tobacco moistener simply by adding moisture-retaining plaster of Paris. Paint the box or rub it with steel wool, punch holes in top and sides, fill with plaster, and add water. The water should be replenished every few weeks.—G. E. H.




## Invisible Tape Fastens Wires

WIRE fastenings can be made almost invisible by the method illustrated above. Tack 1½" strips of cellulose tape to the baseboard at appropriate intervals. Leave the gummed side out, and wrap the tape tightly around the wire.—JOHN A. VINCENTI.




## Fluorescent Lamps Double As Illuminated Signs or Markers

MERCHANTS and householders who are planning the installation of fluorescent lighting fixtures may want to consider the possibility of putting the lamps to double use. Enameled lettering on the tubes, as in the suggestion illustrated above, makes convenient department markers in stores. Used in the same way, they can add to a window display.

Residential applications are more limited, but when the position of the lights permits they may be used as address or name plates, or professional or business shingles, or the like.—FRANK SHORE.

## GREEK ALPHABET [STANDARD SYMBOLS]

| Name | Capital Letter | Small Letter | Used to Designate |
|---|---|---|---|
| Alpha | A | α | Angles. Area. Coefficients. |
| Beta | B | β | Angles. Flux density. Coefficients. |
| Gamma | Γ | γ | Conductivity. Specific gravity. |
| Delta | Δ | δ | Variation. Density. |
| Epsilon | E | ε | Base of natural logarithms. |
| Zeta | Z | ζ | Impedance. Coefficients. Coordinates. |
| Eta | H | η | Hysteresis coefficient. Efficiency. |
| Theta | Θ | θ | Temperature. Phase angle. |
| Iota | I | ι | |
| Kappa | K | κ | Dielectric constant. Susceptibility. |
| Lambda | Λ | λ | Wave length. |
| Mu | M | μ | Micro (millionth). Amplification factor. Permeability. |
| Nu | N | ν | Reluctivity |
| Xi | Ξ | ξ | |
| Omicron | O | ο | |
| Pi | Π | π | Ratio of circumference to diameter=3.1416. |
| Rho | P | ρ | Resistivity. |
| Sigma | Σ | σ | Sign of summation. |
| Tau | T | τ | Time constant. Time phase displacement. |
| Upsilon | Y | υ | |
| Phi | Φ | φ | Magnetic flux. Angles. |
| Chi | X | χ | |
| Psi | Ψ | ψ | Dielectric flux. Phase difference. |
| Omega | Ω | ω | Capital letter, ohms. Small letter, angular velocity. |

A RADIO tube with a whosis of 12, and a whatsis of 3.000, is probably pretty good, but it's hard to be sure.

Greek letters are constantly popping up in scientific and technical writing, and many people have trouble remembering what they stand for because they are usually used without explanation. If you've been calling the symbol for phase angle "Joe," it's time to get acquainted with "Theta." All the other Greek letters, and some of the things they commonly refer to, are given in the table at the left.

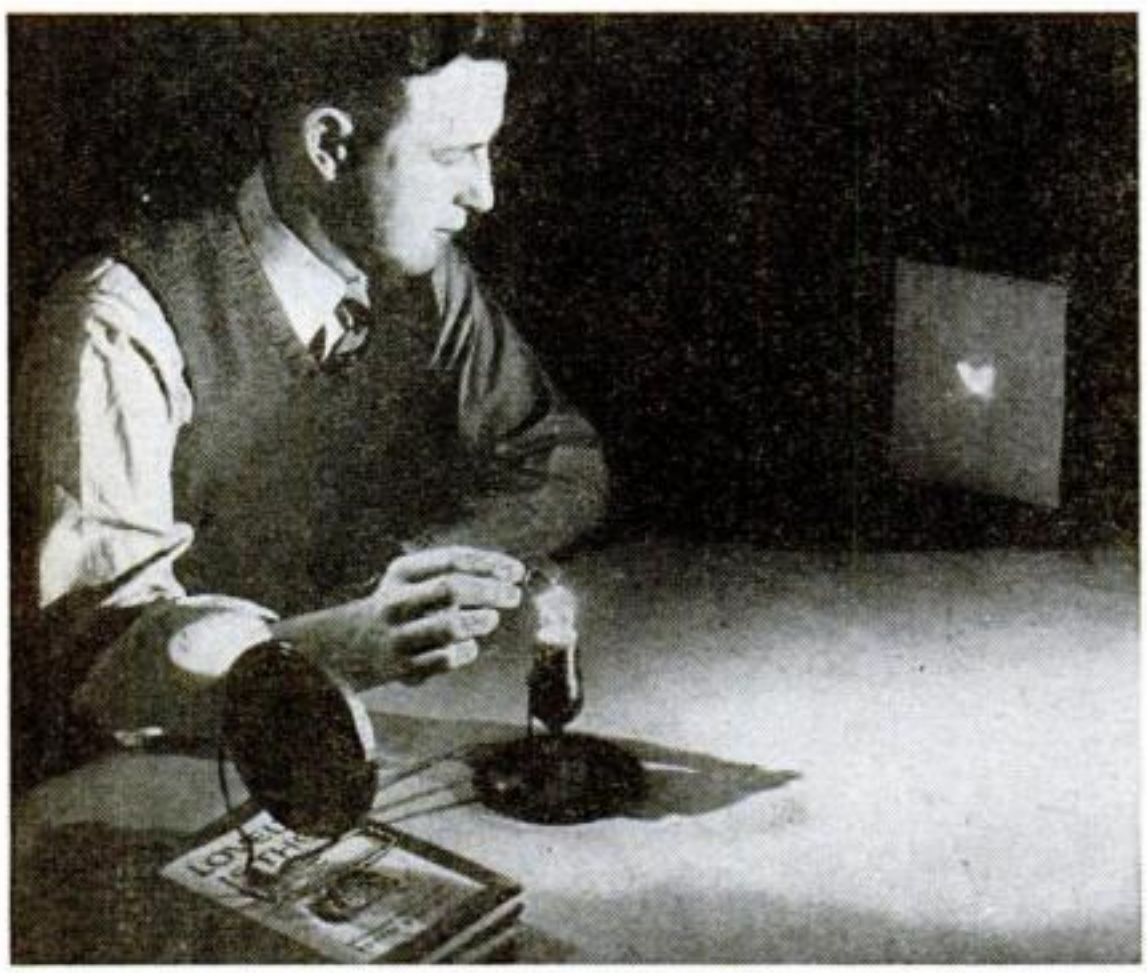
POPULAR SCIENCE MONTHLY SHOP DATA



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# HOME EXPERIMENTS WITH CURIOUS

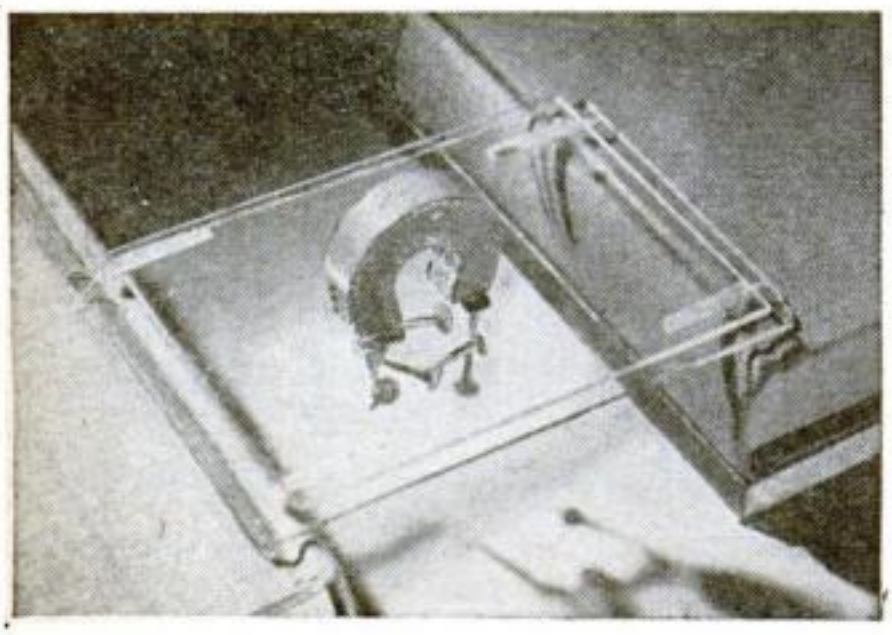
ALNICO magnets open up new fields for the home experimenter, for they are far stronger than ordinary steel magnets of equal size. They are so powerful, in fact, that one, in a special assembly, has been recorded as lifting 4,450 times its own weight. During the war these supermagnets were under high priority, but they now are again available to civilians, and two small ones will serve for the following experiments. Alnico is the trade name for a hard and brittle alloy of aluminum, nickel, cobalt, and iron. Because of their strength, these magnets are used in place of electromagnets.

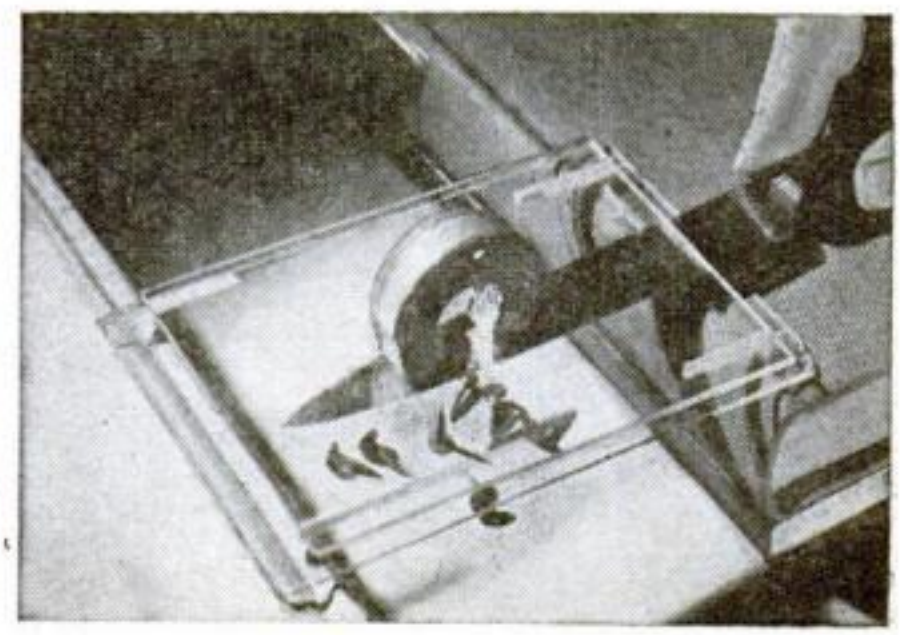


**MAGNETIC FIELDS** surround all electrical conductors. In the case of alternating current, the field rises and falls and reverses its polarity with the alterations of current. You can show this by adjusting a magnifying shaving mirror and a sheet of white paper on opposite sides of a clear 115-volt bulb until the image of the bulb filament is in sharp focus and enlarged on the paper. If you now bring a magnet near the lighted bulb, the filament image will begin to vibrate. The closer the magnet approaches, the stronger the vibration becomes. The explanation: as the field reverses its polarity, the filament is alternately attracted and repelled.

**MAGNETIC LINES OF FORCE** pass freely through nonmagnetic materials, whether they are conductors or nonconductors of electricity. To demonstrate this, separate two plates of glass with matchsticks, so that there is a slight air space, and arrange them between two books like a bridge, as below. Then strew several tacks under the bridge and stand an alnico horseshoe magnet, poles down, on the upper glass. Even though two thicknesses of glass and a layer of air intervene, the magnet immediately draws the tacks against the underside of the lower glass.

You can now use the same setup to show that magnetic materials, such as iron or steel, act as a barrier to the lines of force from a magnet and cause the field to withdraw. Leave the magnet and tacks in place, and insert the blade of a carbon-steel knife between the sheets of glass, directly beneath the magnet. As the blade comes between the magnet and tacks, it intercepts the powerful magnetic field, and the tacks fall off.

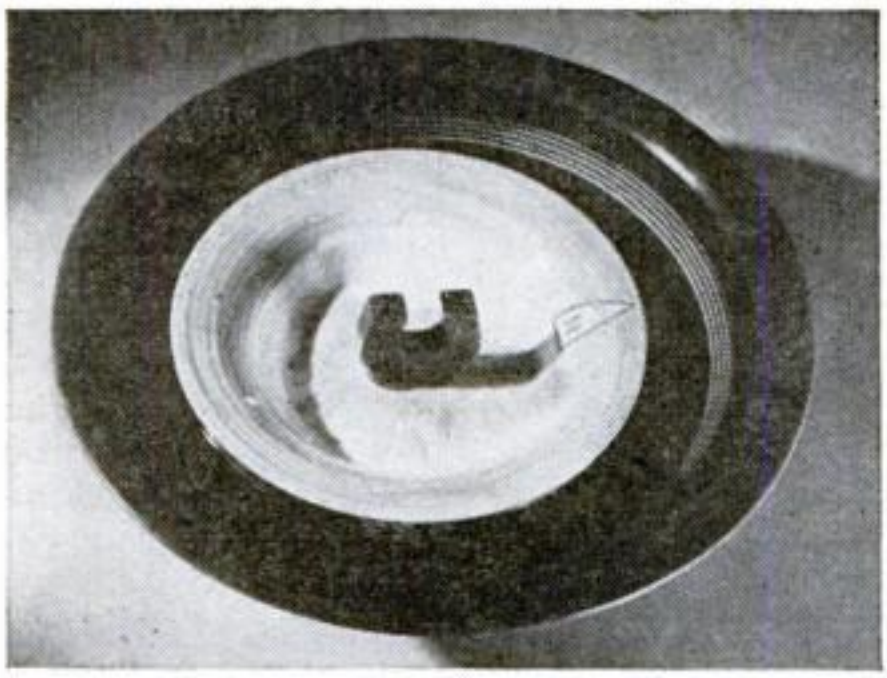


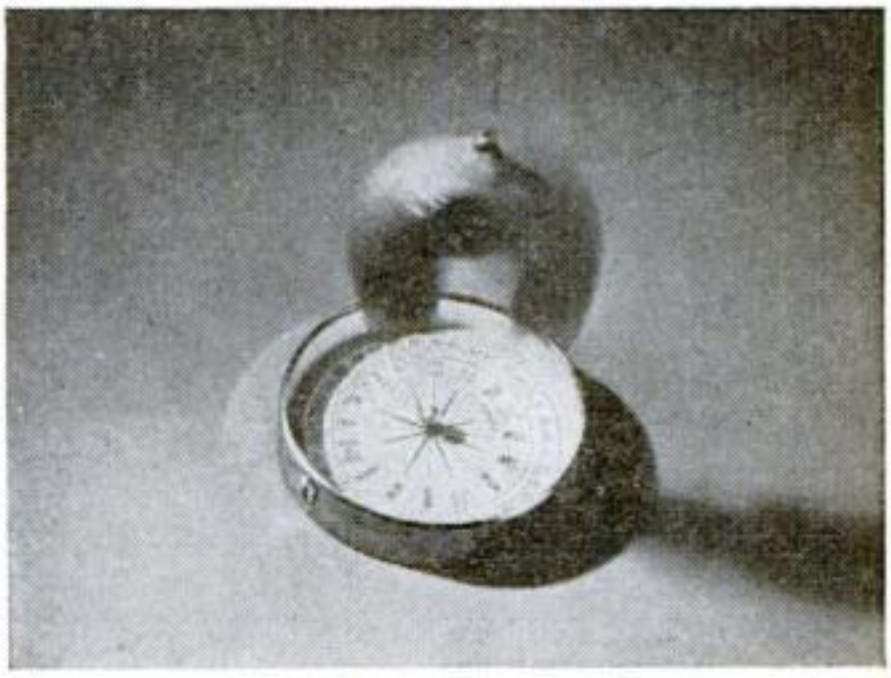




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# STUNTS WITH SUPERMAGNETS

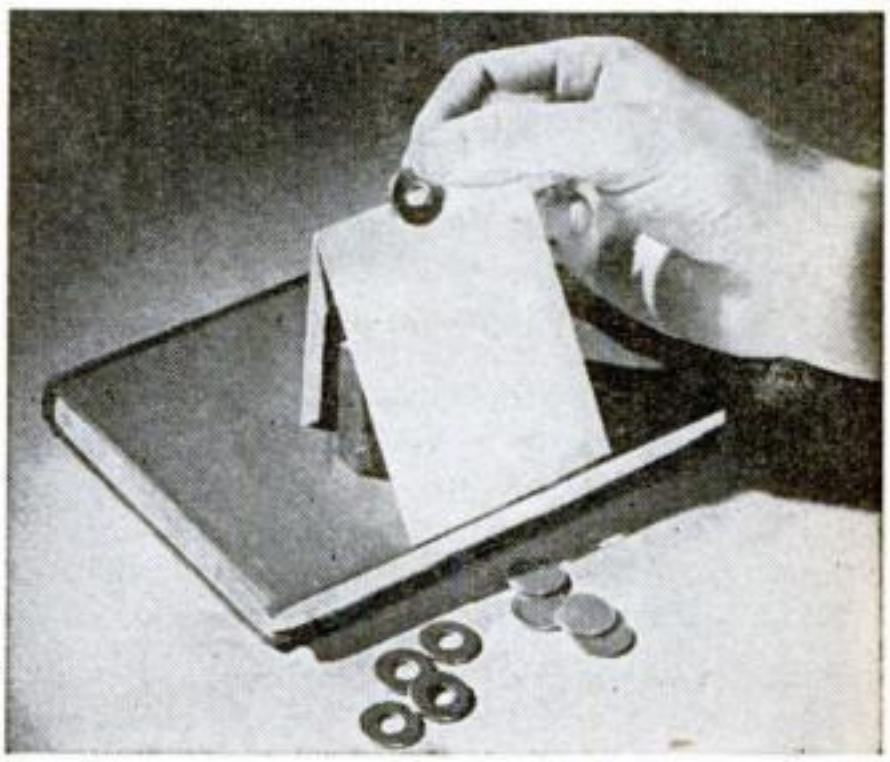


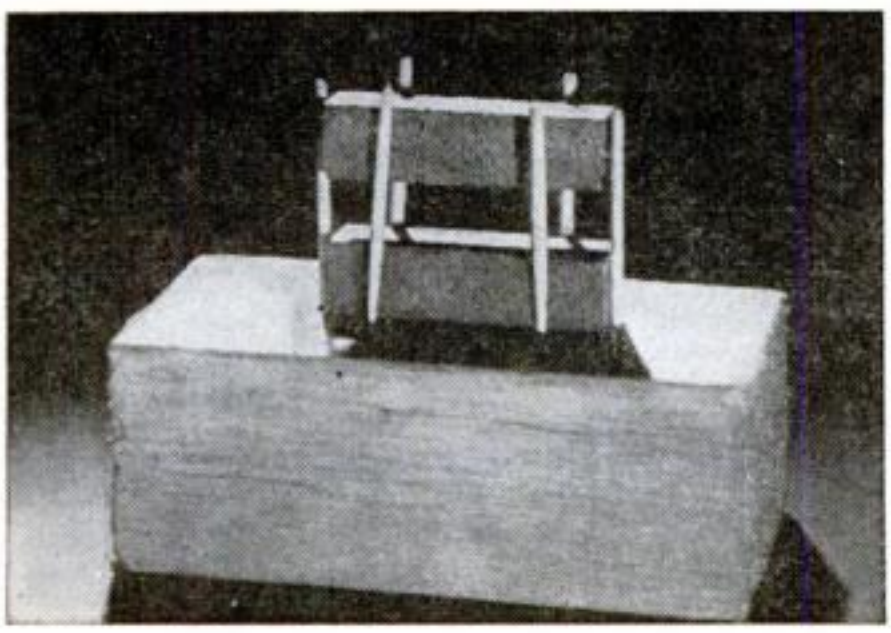


**MAGNETIC COMPASSES** of the pivoted type were probably first tried in the early part of the 13th Century. Before that time, records spoke of lodestones, or natural magnets, mounted on wood and floated on water, and of such things as floating iron fish that "pointed north with their heads and south with their tails." None of these ancient compasses could compare in orienting force, however, with one that you can improvise by placing an alnico magnet in a saucer floating in a nonmetallic dish.

**SUSPEND A MAGNET** by a string several inches above a pocket compass, as above, twist the string, and then release it. As the magnet revolves, the compass needle will follow its movements precisely, although there is no mechanical connection between the two. This principle has been given a practical application in a chemical stirring device now in use. Placed in a chemical solution in a flask or beaker, a magnet revolves and stirs the solution when another magnet outside is rotated by a motor.

**LEVITATION,** the illusion of a heavy body hovering in air without support, has long been a favorite act of magicians. In their hands, the effect is obtained by trickery, but you can achieve the same result with two bar magnets—and no trickery is involved. Stick several toothpicks, or other nonmagnetic objects, into a block of wood around the edges of one magnet, as below, to serve as guides. Then place the second magnet above the other, with the poles of both in the same direction, and repulsion keeps the second suspended. The toothpicks should be loose and offer no vertical support.

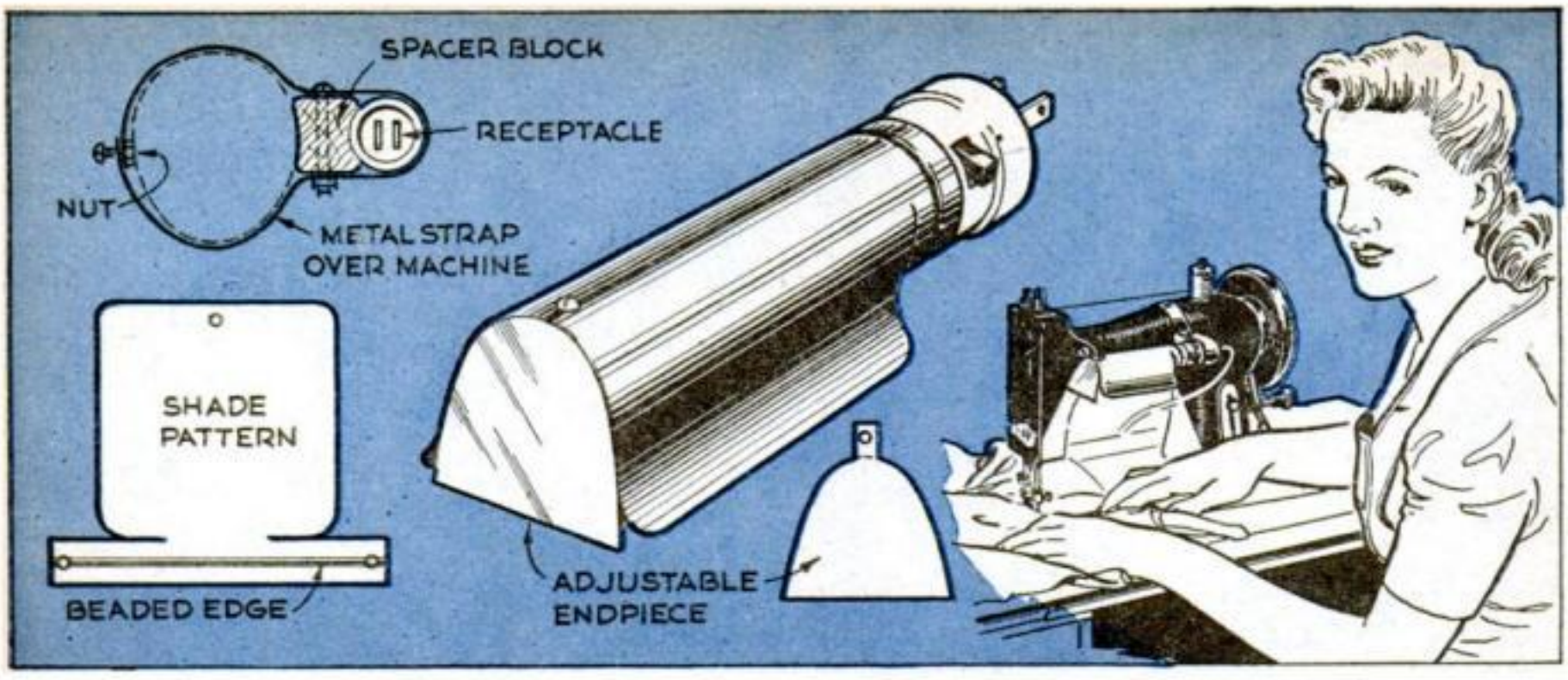




**COIN MACHINES** reject iron or steel slugs by magnetism. The principle by which this is accomplished can be demonstrated as above. Stand a bar magnet on end and bend a piece of cardboard over it so that the top of the magnet is about a third of the way from the top of the slope and to one side of the center. Then slide a succession of coins and iron washers down the slope, starting each from the exact center. The coins (except wartime zinc-coated ferrous pennies) will fall straight. The washers swerve aside.



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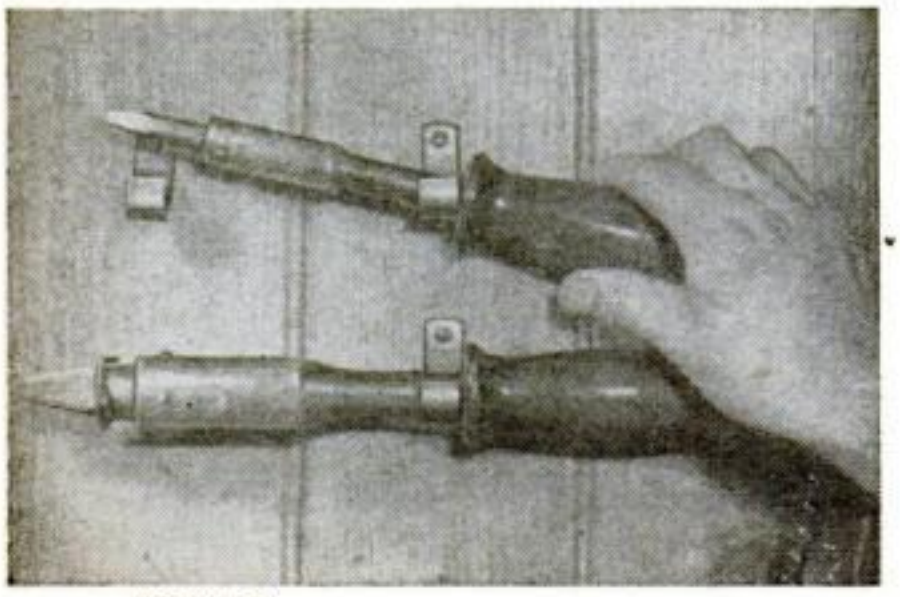

## Sewing-Machine Lamp Uses Night Light and Tin-Can Shade

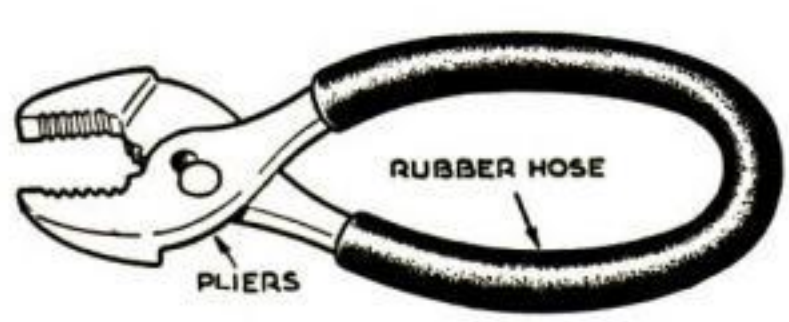
GOOD sewing demands good light. The sewing-machine lamp illustrated above can be improvised from a few odds and ends, but it will be quite as satisfactory as relatively expensive commercial ones.

The socket is a plastic night light of the kind having a snap switch in the body, while the lamp itself is a candelabra-base bulb that is somewhat brighter than the one furnished with the night light. A sheet-metal strap and spacer block clamp the female receptable to the sewing machine arm, permitting the light to be readily inserted or removed as needed. Ordinary tin-can stock, polished with steel wool before shaping, serves for the shade. If possible, use a coffee can, since the beaded shoulder is ideal for snapping around the night-light neck. A separate endpiece lets you reflect the light to where it's needed most.—G. E. H.

## Racking Hot Irons After Use Prevents Accidental Burns

WITH a pair of picture hangers used as supports, hot soldering irons can be safely racked on the shop wall immediately after use. Flatten the smaller curve of each hanger, and drill for a screw. As can be seen in the photograph below, the smaller iron (top) fits perfectly across two hangers. For the larger iron at the bottom, a bent curtain-rod screw hook is used to support the oversized point; the thinner section, near the handle, rests in the curve of a picture hanger. Be sure that the hooks are mounted on a noninflammable surface.—J. BACHNER.






## Hose on Pliers Acts as Spring

MECHANICS who often have to manipulate pliers with one hand will find that a short piece of rubber hose makes the job easier. Slipped over both handles, the hose tends to spring the jaws open when the grip is relaxed, so that it is unnecessary to shift fingers after each twist.—ROBERT BLAKER.

## Plastic Paint Insulates Tools

IF YOU find friction tape and rubber tubing become grimy and irritate your skin when used to insulate your electrical tools, try painting the handles with dissolved clear plastic instead. To make the plastic "paint," collect some plastic filings or shavings, put them in a bottle, and add an equal amount of acetone to dissolve them.

Several coats of the solution should be applied to the tool handles. Gripping surfaces can be roughened with a file, but don't bare the metal.—B. BILLINKOFF.



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# LOOKING AT A LOG WITH YOUR MICROSCOPE

## Shavings from a Carpenter's Plane Reveal Structure of Common Woods.

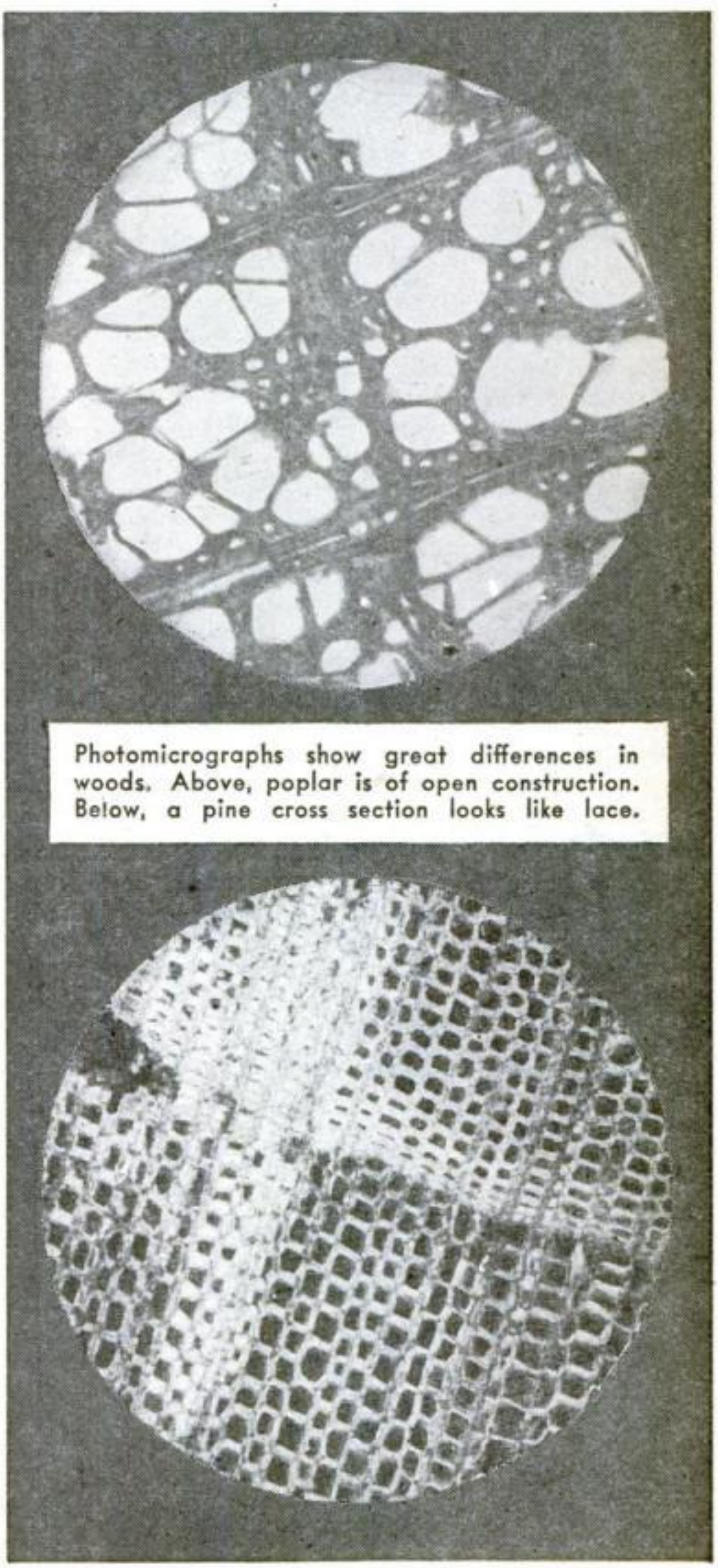
By MORTON C. WALLING

DIFFERENCES in various kinds of wood are readily visible to the unaided eye, and identification is usually easy. But what a world of weirdly beautiful textures, normally unseen, become apparent when thin shavings are placed under a microscope!

Shavings cut with a carpenter's plane may be used. Hone the plane iron to razor sharpness, adjust it to cut a shaving thinner than tissue paper, clamp the wood securely, and plane parallel to the grain. Pick up one of the shavings with tweezers, and placing it on a 1″ by 3″ glass microscope slide, hold it flat with a clean cover glass. Clean the plane, cut some shavings across the grain, and also mount one of these.

Under the microscope, the cross section resolves itself into a lacy network of tiny openings consisting of the walls of cells that have been sliced across. At the lower magnifications, it will be seen that these are arranged in curved bands. Near one edge of each band the cells become smaller and smaller. This is wood that grew in the late summer and fall. Then, suddenly, the cells become very large, indicating where rapid spring growth began the next annual ring.

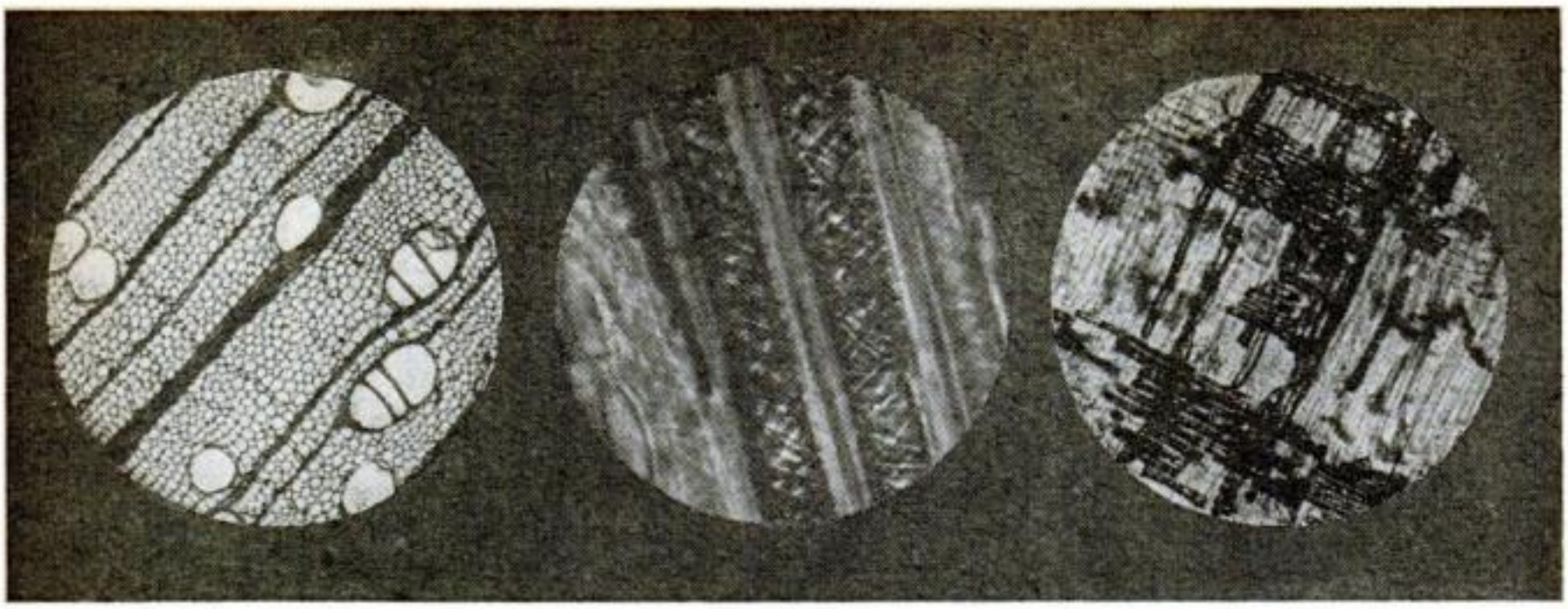
Here and there are large openings. These are resin ducts or canals. And straight rows of cells that usually are elongated run across the annual rings. These are medullary rays, cells



Photomicrographs show great differences in woods. Above, poplar is of open construction. Below, a pine cross section looks like lace.



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Large duct openings in a walnut cross section, left, are visible to the naked eye, and medullary rays are prominent in the radial oak section, right. Yew wood that was cut with the grain is seen in the center.

that extend radially through the trunk of the tree.

It is possible to cut two kinds of sections parallel to the grain of wood. One is the radial section, cut on a plane extending along a radius of the tree trunk. This may show the sides of cells that comprise the medullary rays. The other is a tangential section. As its name suggests, this is cut at an angle to the radius. The cells of medullary rays are cut crosswise.

When you examine longitudinal sections of different kinds of wood with a microscope you will observe that cell walls exhibit various forms. In pine, most of the cells are tracheids, characterized by considerable length and numerous pits with ring-shaped borders around them, and there are occasional resin canals. In some woods, the cells may show spiral markings. The ducts, made up of short cells whose partitions have been absorbed, have walls that are marked by spirals and pits. Sometimes the ducts are single rows of cells. At other times they consist of numerous rows visible to the unaided eye, as in walnut and oak.

In some cases it may be desirable to stain the wood so that certain details may be more clearly seen. You can do this by applying iodine, mercurochrome, a wood stain, or one of the various microscope stains. One way is to place the shavings on a glass slide, add two or three drops of water, and then a drop or two of stain solution. Or you can immerse the sections for a time in a bottle or jar of stain. After application of a water stain, rinse the specimen in clear water, preferably distilled, to remove excess coloring. Such stained sections may be observed dry, in water, or mounted permanently in Canada balsam.

This balsam preferably should be of the filtered variety made for microscope work. The specimen must be free of water. If there is any doubt about its dryness, it may be kept for a time in a warm dry place.

## CHEMISTRY QUIZ



EACH of the following lines describes one of the metals listed below. Indicate your answer by placing the number of the line next to the name of the proper metal.

1. Can you name a metal that cuts glass with ease,

2. And another as soft as the wax of bees?

3. A third is so heavy it weighs more than lead,

4. While a fourth could float upon water like bread.

5. Now there's one you can beat to your heart's content;

6. Still another's so brittle it snaps when it's bent.

7. There's a metal that melts while it's colder than snow,

8. And there's one that resists the coal's hot glow.

9. Now, this one will break under stress that is slight,

10. But the last may be labeled the metal of might.—F.S.

—Bismuth
—Steel
—Antimony
—Tungsten
—Lead
—Lithium
—Chromium
—Potassium
—Mercury
—Gold

## CONTRAST IN METALS

ANSWERS:

1. Chromium. 4. Lithium. 7. Mercury. 10. Steel.
2. Potassium. 5. Gold. 8. Tungsten.
3. Bismuth. 6. Antimony. 9. Lead.



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# Cellulose...

## MYSTERY COMPOUND IN PLANT LIFE

### Chemists Still Don't Know the Size of Its Molecule.

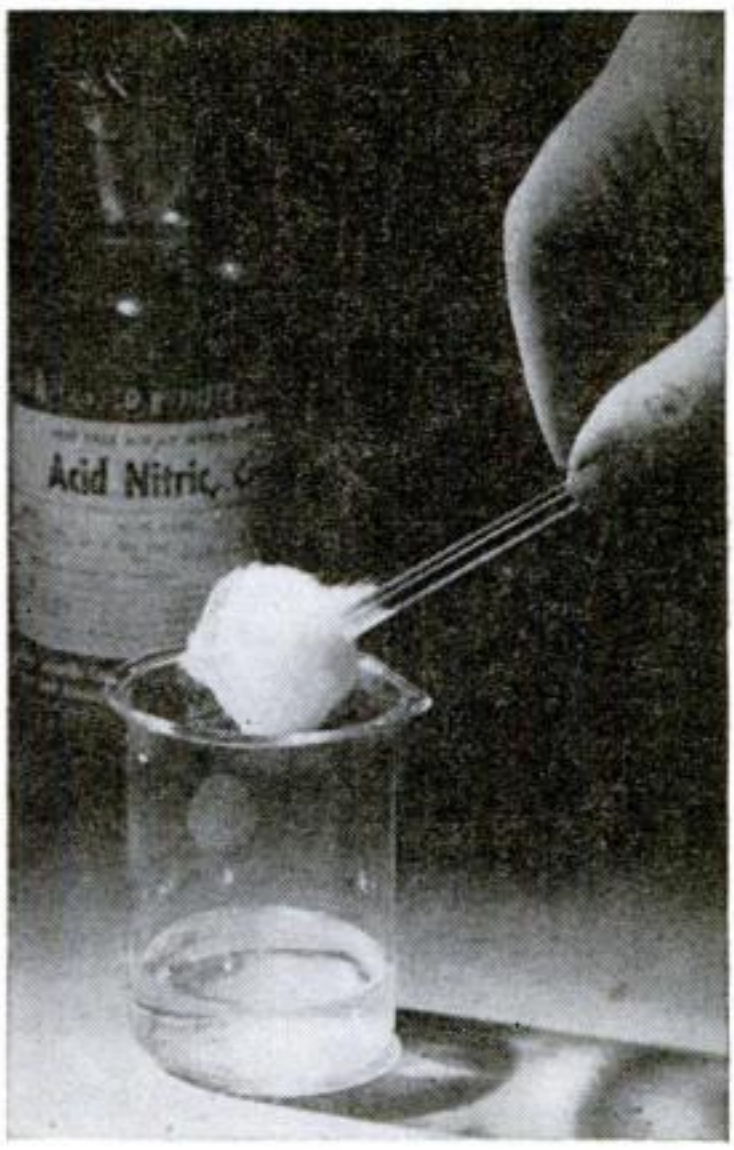
By KENNETH M. SWEZEY

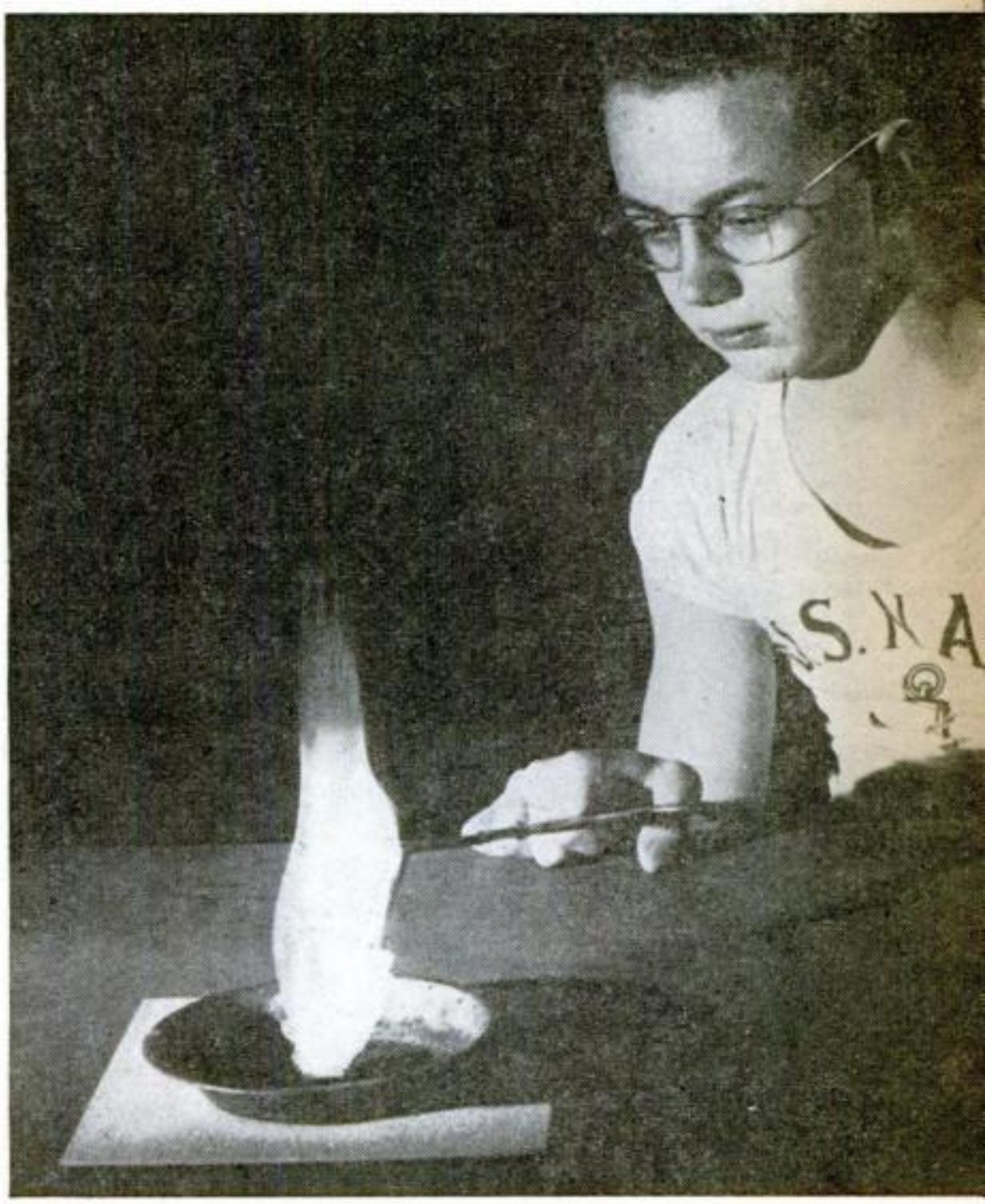
CELL WALLS and the supporting framework of all trees and plants on the earth consist largely of cellulose, but this complex substance, strangely enough, is still one of the most mysterious of chemical compounds. Its common formula is exactly the same as that of starch $(C_6H_{10}O_5)x$, with the $x$ signifying an unknown number of units which make up its giant molecules. But unlike starch, cellulose does not dissolve in any ordinary solvent and cannot be changed by the digestive juices into food for the human body.

Largely because of its refusal to go into solution without becoming chemically changed, chemists never have determined the exact size and structure of the cellulose molecule. Yet, despite this lack of precise knowledge, dozens of practical wonders are worked with this plentiful material.

Untreated cellulose, such as cotton, linen, jute, and other plant fibers, has been fashioned into textiles and ropes since the beginnings of history. Rayon, the modern competitor of these natural fibers, is made by chemically breaking down the cellulose of trees, dispersing in a liquid, and regenerating it in the form of strong silklike threads. Similarly, cellophane is regenerated cellulose that has been pressed between rollers. Paper is made of cellulose from trees or cotton, ground up, chemically treated, and finally squeezed into sheets.

Next to textiles and paper come important

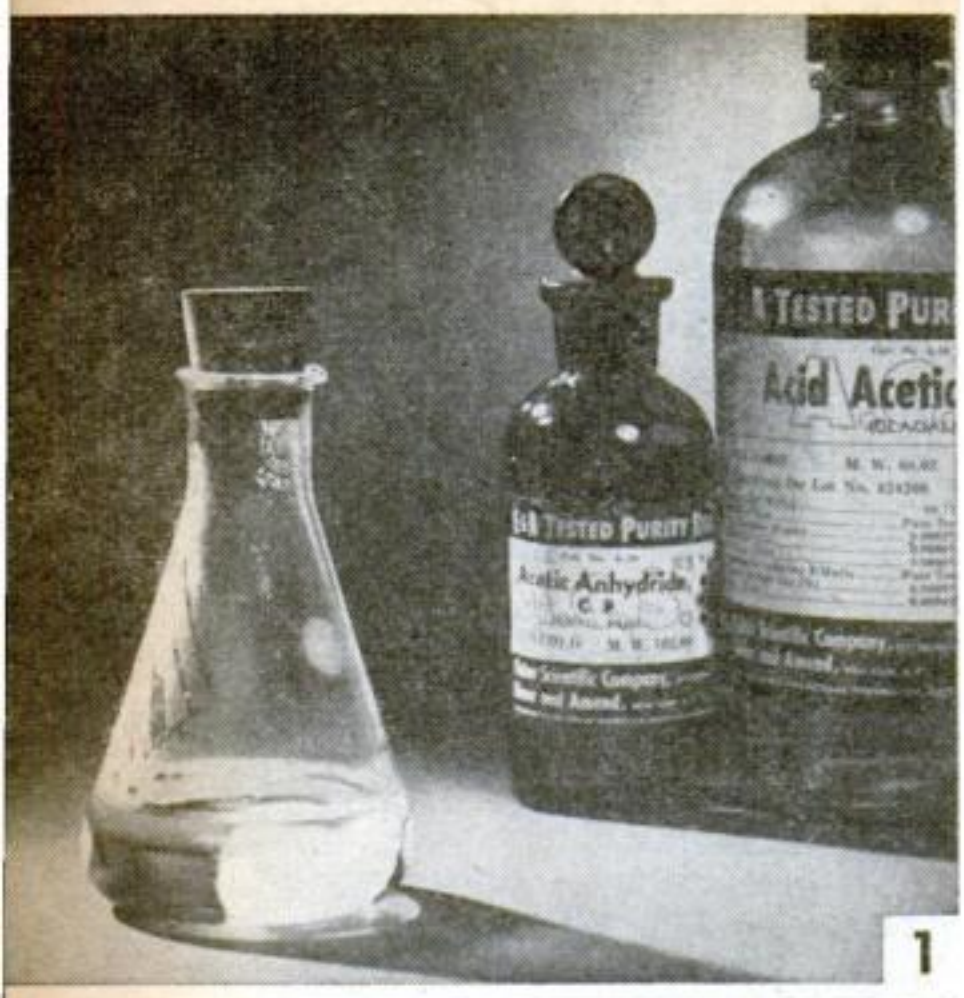


Cellulose, such as the wad of absorbent cotton above, yields pyroxylin when it is treated with a mixture of nitric and sulphuric acids in a carefully controlled process. At the right, dried pyroxylin burns furiously. Pyroxylin is used for paints and many other important items.



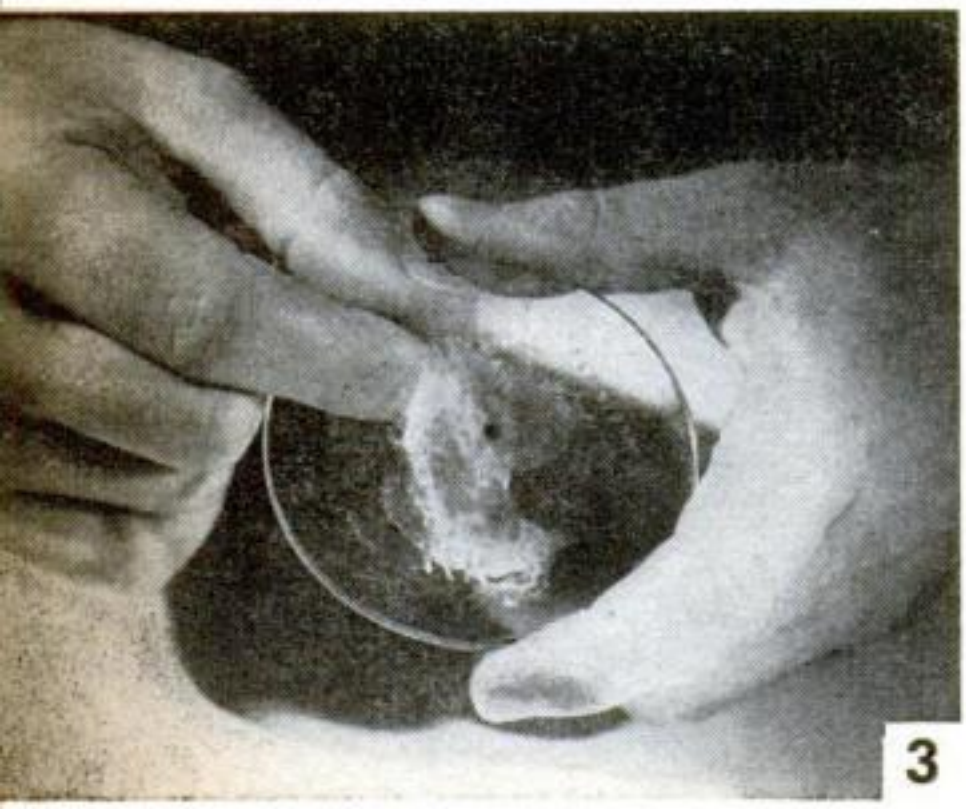
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products derived from the nitrocellulose family. These include smokeless powder and other explosives, photographic film, collodion, celluloid and related plastics, paints, dopes, lacquers, cements, and finger-nail polishes.

When cellulose is attacked by concentrated nitric acid, certain hydrogen-oxygen groups of the cellulose units join with the hydrogen of the acid to form water. At the same time cellulose nitrate is formed. This nitration takes place in stages, depending upon the concentration and temperature of the acid and the length of treatment.

When maximum nitration occurs, highly explosive guncotton results. Lesser nitration yields the nonexplosive pyroxylins, or "soluble cotton," used for paints, films, and plastics. Guncotton is too dangerous a substance to be made in the home laboratory, but the lower nitrated pyroxylins can be produced safely.

Carefully mix exactly 5 ml. of water, 34 ml. of concentrated sulphuric acid, and 15 ml. of concentrated nitric acid in a beaker. Cool the mixture to 30 deg. C. by standing the beaker in a pan of water at that temperature, and then add ½ gram of absorbent cotton in one piece. Stir the cotton in the solution occasionally, and maintain at the 30-deg. temperature for 20 minutes.

Then remove the nitrated cotton with a glass rod and immerse it immediately in a large beaker of cold water. Wash thoroughly in cold water and finally in warm water. When the washings no longer show an acid reaction to litmus paper, squeeze the cotton as dry as possible and spread out to dry at room temperature.

This is your pyroxlin. When it is dry, put a small piece in an upturned jar cover and light it cautiously *with a match held in tongs.* It should burn furiously.

Collodion, a liquid once used extensively to protect skin abrasions, can be made from the remainder of your pyroxylin. Place it in a test tube containing 5 ml. of ether and 5 ml. of ethyl alcohol. Cork the tube and allow it to stand overnight. The next day pour off the clear solution—the collodion. Put a little in a glass plate and allow the solvent to evaporate. When dry, the pyroxylin that remains can be removed as a continuous film, a close relative to photographic film.

Cellulose acetate is more expensive to manufacture than pyroxylin or cellulose nitrate, but the fact that it burns only with difficulty makes it valuable where there is danger of fire. Cellulose acetate also is the basis of a group of plastics. Spun into thread, it is the textile "Celanese."

To make cellulose acetate, put 20 ml. of glacial acetic acid and 5 ml. of acetic anhydride

Cellulose acetate is produced by dissolving cotton in acetic acid and acetic anhydride (1), then stirring in water (2), drying the precipitate, and dissolving in chloroform. The resulting film (3) is noninflammable.



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into a small Erlenmeyer flask and add 3 drops of concentrated sulphuric acid to act as a catalyst. Submerge ½ gram of absorbent cotton in the solution with a glass rod, stopper the flask, and let it stand for eight hours or so until the cotton disappears. Then slowly pour and stir the solution into water in a large beaker. Collect the gelatinous precipitate by filtering the solution through a large funnel. Press the water from the precipitate by squeezing between filter papers.

After allowing the crude acetate to dry, put a little in a test tube with a small quantity of chloroform and let it stand, giving it a shake occasionally, until the solid has dissolved. Then pour some on a glass plate and allow the solvent to evaporate. As with collodion, a film will form. Remove by wetting for a few minutes with water.

If you now hold a piece of your cellulose acetate film in a flame it will burn only while in contact with the flame.

It may sound strange to anyone who has seen filter paper disintegrate in sulphuric acid that a short immersion may so affect the cellulose that the paper is tougher and stronger. Parchment paper is made by this means. See for yourself by carefully adding 2 volumes of sulphuric acid to 1 of water. (Be sure to add the acid to the water.) After the solution has cooled to room temperature, dip a strip of filter paper into it for just 15 seconds. Then wash the paper in water to which a little ammonia has been added and allow it to dry.

Although you can't get nourishment directly by eating sawdust or cotton, chemists can, when pressed by war or famine, transform such forms of cellulose into satisfying food. You can find how it's done by tearing half of a 5" sheet of filter paper into bits and grinding these in a porcelain mortar as you add cold concentrated sulphuric acid, drop by drop. Have the mortar and acid cold, and do not work too fast. When all the paper has disappeared, the solution should be yellowish or light brown. If it turns black, the acid has worked too vigorously. In that case, discard it and try again.

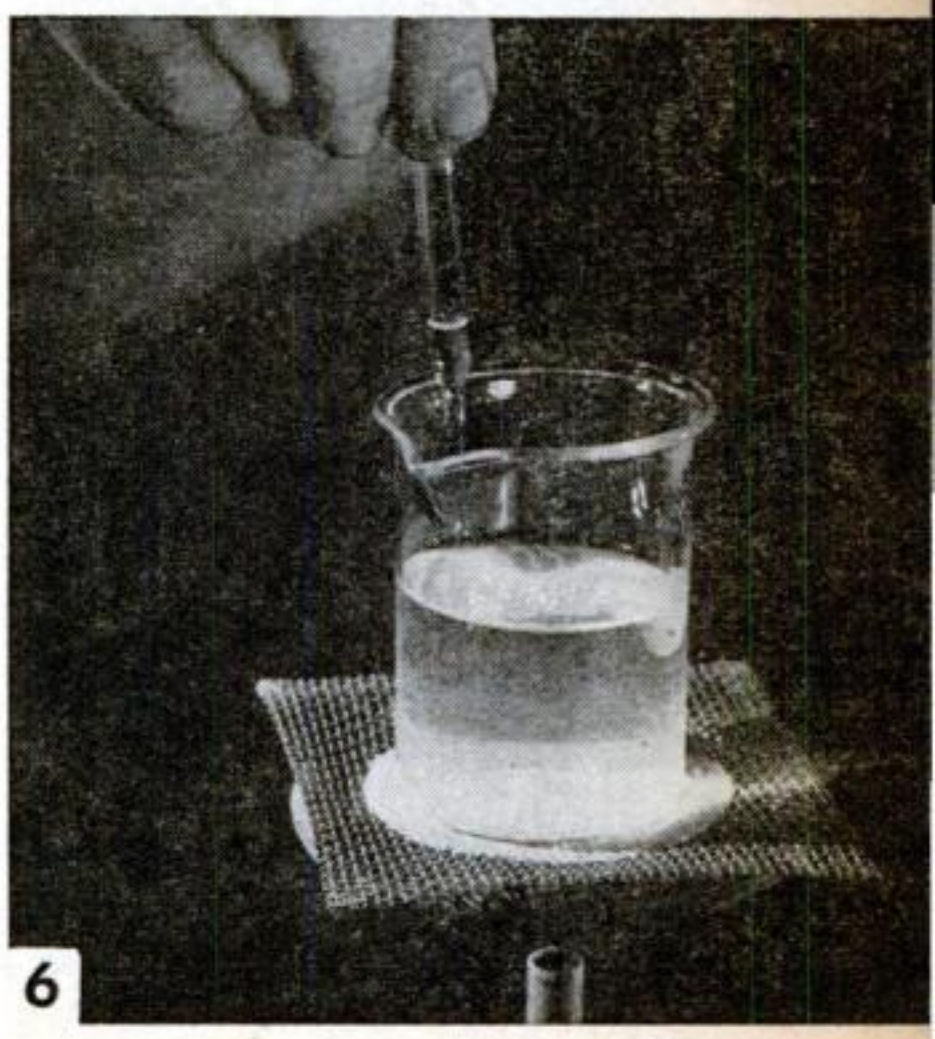
When the paper has dissolved, cautiously add about 50 ml. of water, mix with a glass rod, and transfer to a beaker. Boil this solution gently for half an hour, keeping the volume constant by adding water as evaporation occurs. After cooling, neutralize it with a 20-percent sodium hydroxide solution.

Pour a little of the product into a test tube containing Fehling's solution and heat gently. The blue solution will quickly change to yellow, brown, or brick red, indicating the presence of a reducing sugar—in this case, dextrose.



4


5


6

Dipped into sulphuric acid (4), filter paper turns into parchment. Simple sugar also can be made from paper by grinding in sulphuric acid (5), adding water, boiling, and neutralizing. Tests (6) show sugar is present.



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# SIMPLE REPAIRS





CAREFUL inspection of your folding lawn chairs when you take them out this spring may save a disconcerting spill later in the summer. A few simple repairs will restore them to their original condition. Then if you form the habit of checking and repairing each fall or spring, you can make them last season after season. Repainting, of course, is best in spring, for then the chairs look their newest when in use.

Try the rungs with your hands and replace those that appear weak before they can break and tear the canvas fabric. Hardwood doweling of the same diameter sometimes makes even stronger rungs than the original.

To remove a weak rung, first pry out the tacks holding the fabric and the small nails locking the ends (Fig. 1). If the heads of the locking nails have rusted off, saw the rung in two and twist it out, taking care not to damage the hole.

Measure the old rungs carefully and cut the new ones to exact length so clearance will be maintained, as in Fig. 2. Then paint inside the holes, as shown in Fig. 4, and the ends of the new rungs before assembling to keep out moisture and prevent rotting. Use only an outdoor paint.

Check the rails for cracks and fill any found with calking compound, as in Fig. 3, to keep them from spreading. It is good practice to check for cracks once or twice during the summer, for more cracks may be started by penetration of moisture and the drying action of sun and wind. The tops of the rails are usually the most vulnerable spots.

Canvas that has been snagged but is otherwise strong can be stitched up or patched, but when it is badly worn it is best to replace it with new canvas. If the old canvas is available for measuring, cut the new piece to exact length, using a steel square to get the ends square, as shown in Fig. 5. The length should be the distance between rungs, plus enough material to wrap around each rung 1½ times, plus 1″ or so of slack.

Canvas is easy to replace on rungs before they have been assembled. Simply tack it on, folding the corners under, as in Fig. 6, and round off the tack heads with the hammer, as in Fig. 7, to protect the fabric.

On an assembled chair, start with the lower rung, tacking the canvas on, rounding the tack heads, and wrapping the fabric around, as shown in Fig. 6. Working on the top rung will be a trifle more difficult, for the canvas must be wrapped around it 1½ times before tacking. Figure 8 shows a method of accomplishing this. Set the chair up so the canvas will be slack, and put the first tack in a corner while holding the overlapping material to one side. Then stretch the canvas fully on the rung and put a tack in the other corner the same way. Work in toward the center.

It will not be necessary to remove the canvas every spring, but repaint the rungs whenever possible.—J. MODROCH.



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# RESTORE LAWN CHAIRS



Fig. 1



CHAIR FOLDED UP
Fig. 2

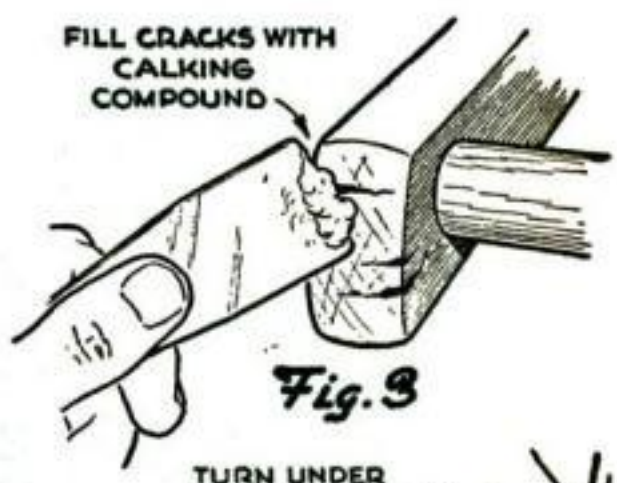
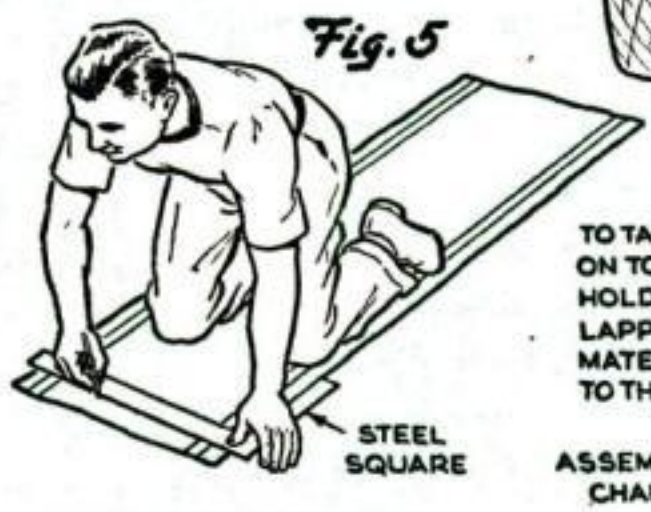


Fig. 3



Fig. 4


Fig. 5

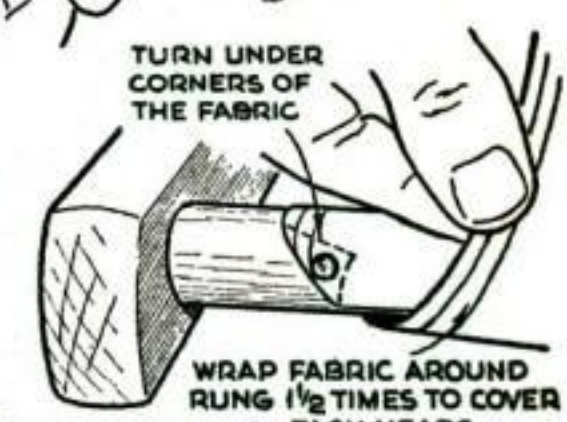


Fig. 6



Fig. 7



CUT ENDS SQUARE TO MAKE FABRIC HANG EVENLY

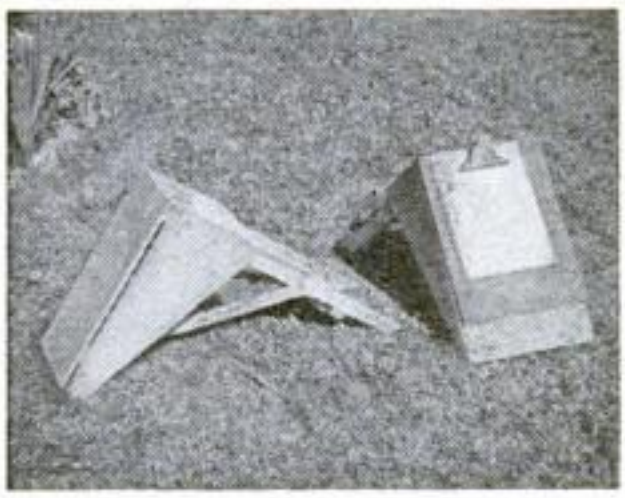


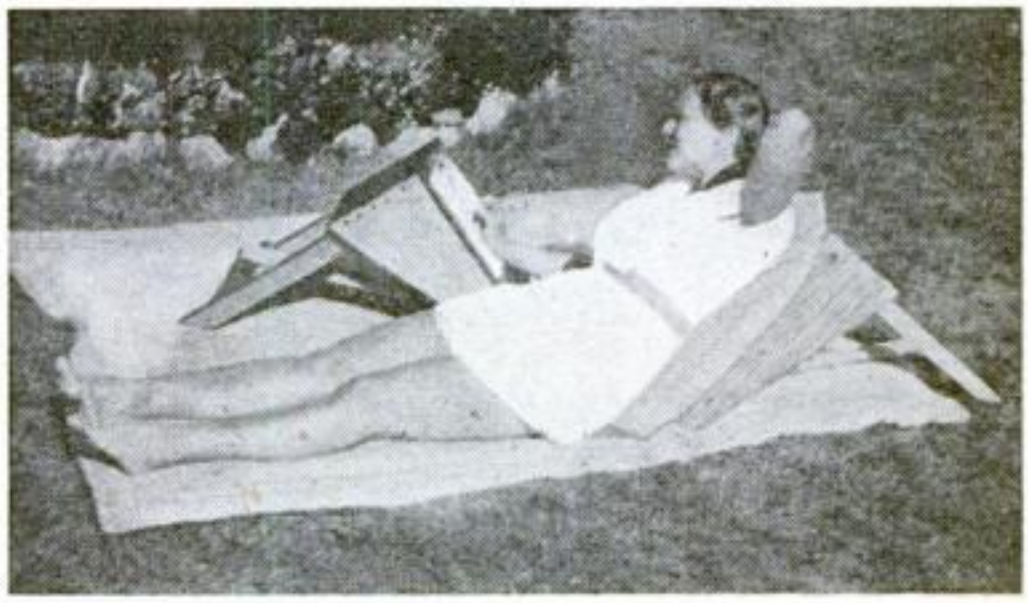
Fig. 8

-PATRICK-

## Back Rest and Writing Board Made from Single Box

TWO convenient back rests can be cut from one apple box or small packing case and braced in a jiffy for use on the lawn or beach. With a clamp from a hard-backed billing board attached, as indicated below, one can be converted into a comfortable writing desk or sketching board.—KENDRICK M. MARTIN.


An ordinary box sawed in half is an aid to lolling on the lawn or beach.





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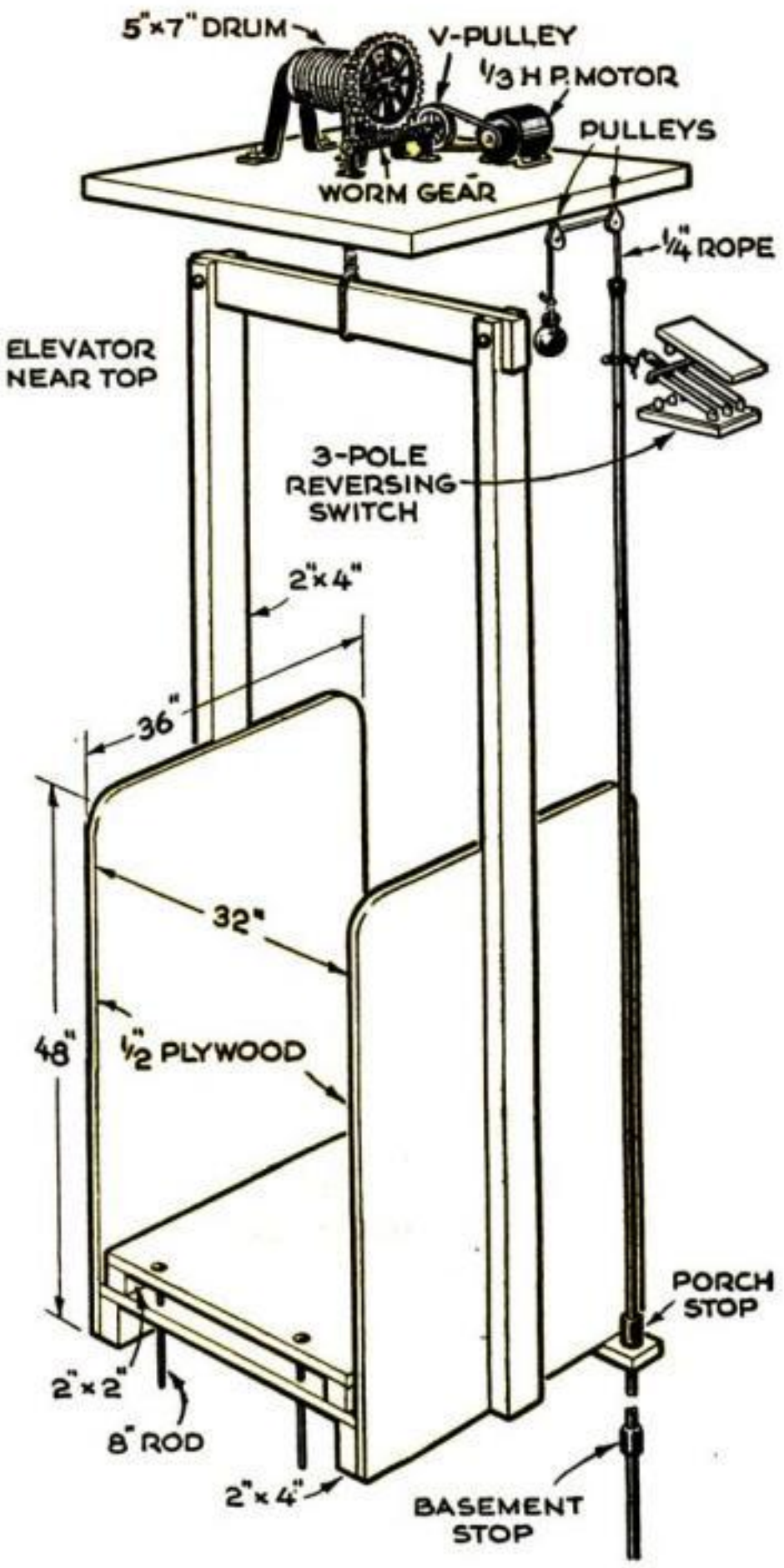
# HOMEMADE ELEVATOR GIVES FARMER A LIFT

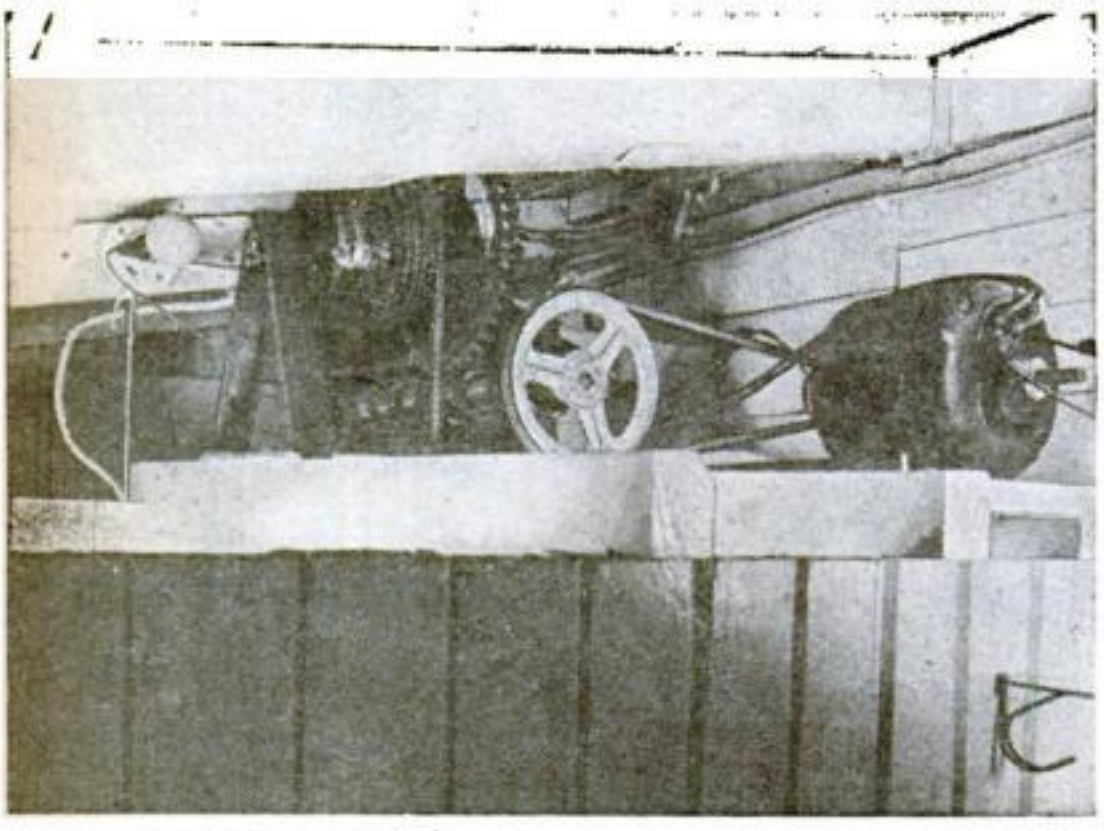
EVERY time John Waggoner, an Illinois farmer, has to bring up a case of eggs from the basement, his private elevator stands ready to give him a helping hand. Running from the porch to the basement, the homemade hoist has power and space for a payload as well as a passenger.

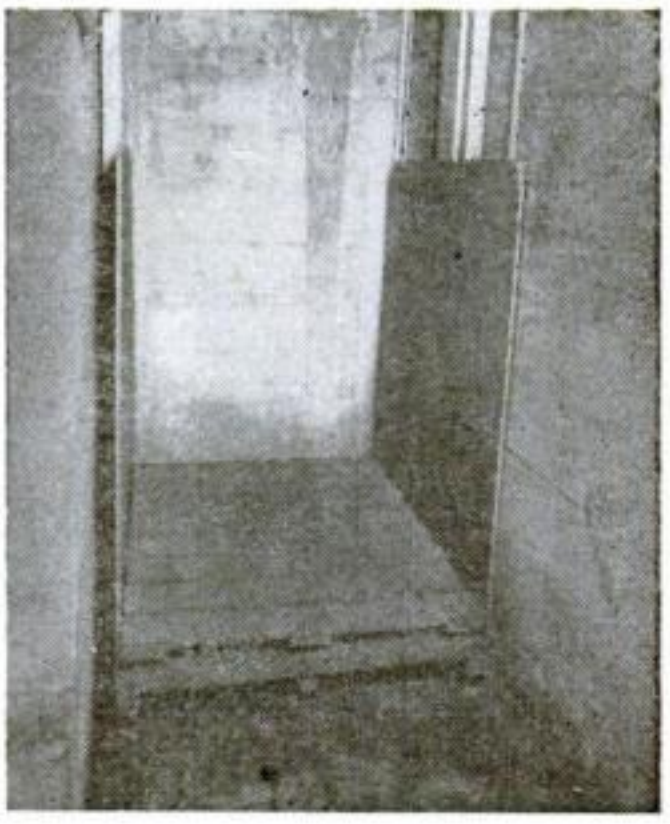
The motive power is a 1/3-hp. electric motor that drives a 1-to-40 worm gear through a 1½-to-5 V-belt combination. A length of 5" iron pipe serves as the drum. From the hoisting-machinery platform a counterbalanced wooden rod runs down to the basement, and is linked to the reversing switch. The latter is a knife switch modified so that one set of poles is above the other.

If Waggoner is in the basement and wants a ride up, he steps aboard the elevator and pulls down on the control rod alongside. The car then rises until the porch stop lifts the rod up, stopping the car. On trips down he lifts up on the rod and the car descends until the basement stop pulls the control to the neutral position. Since the worm gear is irreversible, a current interruption would do no harm, but Waggoner keeps a stepladder handy, just in case.

Compelled to use a split-phase rather than a repulsion-induction motor, he found that the motor had ample power once it was running but was badly overloaded at the instant of starting on upward trips. Waggoner then built a false floor in the car, supported in the basement by four legs that extend beneath the elevator. This supplementary floor now allows the motor ample starting time before it picks up the load on upward trips.—E. W. LEHMANN.



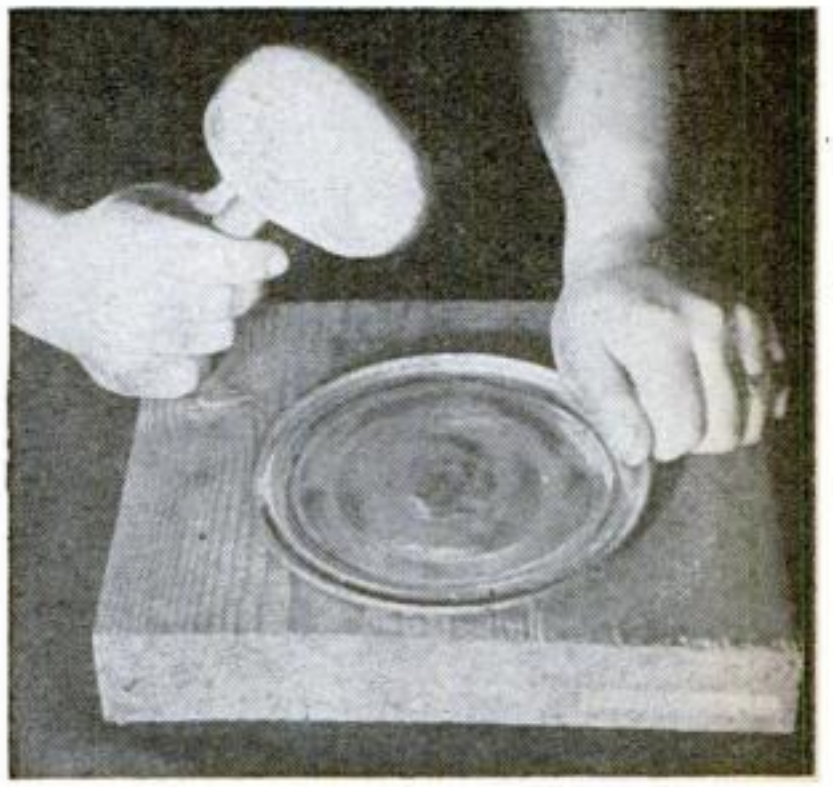


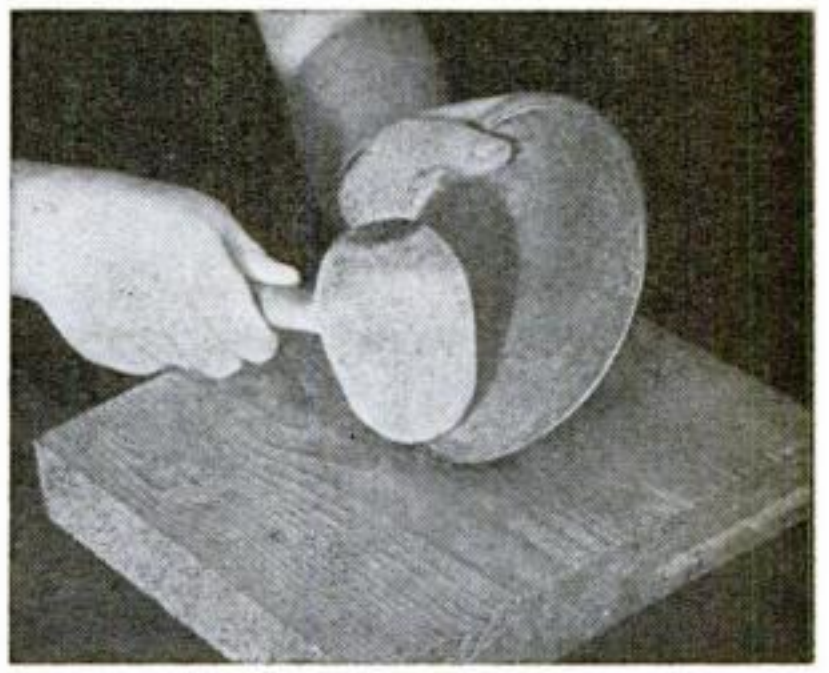


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# Tin-Can Ends Shaped Into Bowls







Two bowls, one hammered from the end of a common tin can and the other from a large pail cover. The small one rests on a wooden stand, shaped as shown below.

HANDSOME hammered bowls can be made from material as prosaic as the ends of common tin cans. The tin plate takes enamel well, and various designs can be painted or stenciled on for ornamentation. Or, simply polished with silver polish, it will work into a bright, satiny finish.

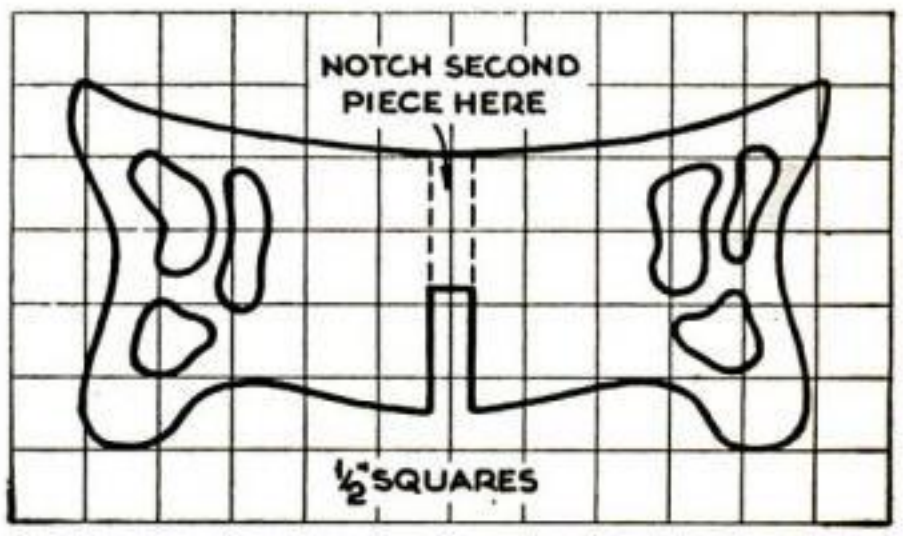
If you have no silversmith's tools, a ball-peen hammer can be used, but there will be less likelihood of dents in the surface if you use a short-handled mallet like the one shown in the photos. Turn the mallet head from maple or other hardwood, making it about 2½" diameter at the center and 4" long. One end should be fairly flat and the other round.

Use hardwood for the block on which to do the hammering and turn or gouge a spherical depression in one face. The block should be of a size large enough for conveniently working your largest bowl.

In cutting the ends of the cans for hammering, you can save the trouble of turning the edge by leaving the bead on the stock. Any size can may be used, even the ends or covers of large tin pails. Large bowls, however, require fairly heavy material.

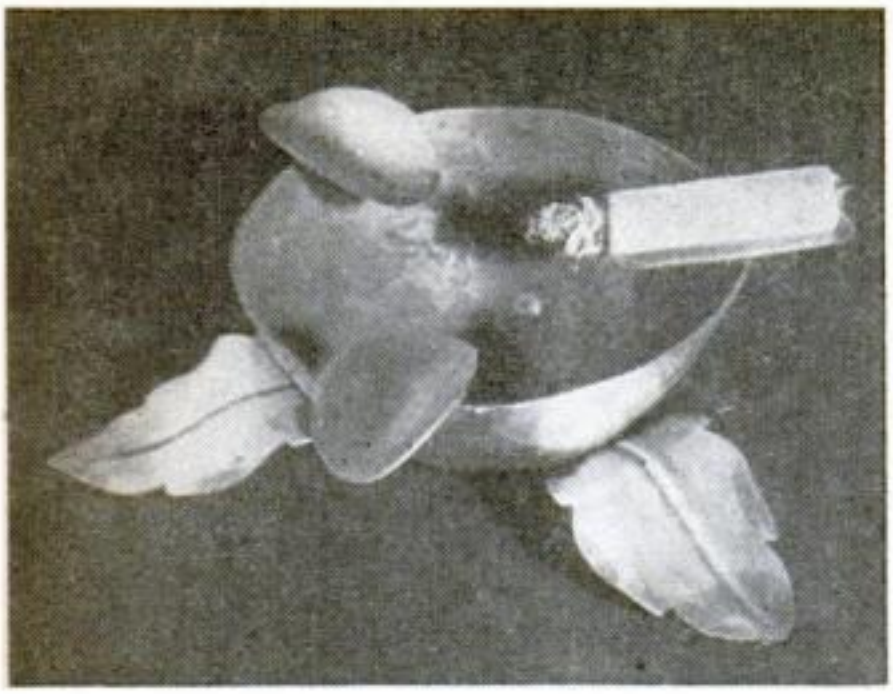
Hammer with the small end of the mallet. Because of the beaded edge, work from the center outward and repeat as often as necessary until the desired depth of the bowl is obtained. Then work over the piece with the broad end of the mallet to smooth out dents, hammering last on the flat side of the block.

Fluted edges are also hammered over the depression. A pattern for a wooden stand is shown below.—ELMA WALTNER.






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## Hammered Copper Tray Has Legs of Bent-Leaf Design

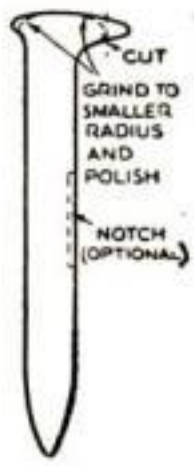
SCRAPS of light-gauge sheet copper from which you can cut a 3⅛" disk, three 1⅛" by 2" pieces, and three ⅞" by 1⅜" ovals are quickly shaped into an ash tray like that shown above. The bowl of the tray is hammered from the inside with a silversmith's raising hammer, as shown in the drawings. Hammer the disk over a 1/16" depression in a hardwood block working repeatedly from outside to the center. Anneal it several times by heating red hot and quenching in water.

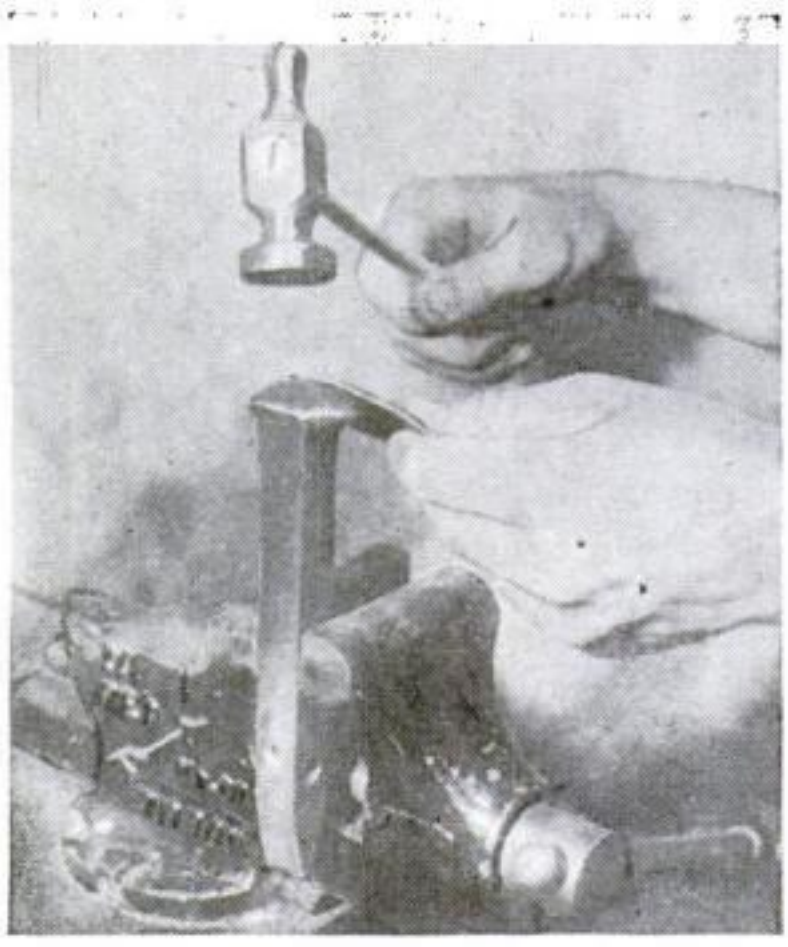
Set the tray on the bench bottom up and scribe around the edge with a scriber stapled to a block just thick enough to bring the scribed line above all edge irregularities. Then cut the edge to the scribed line and file smooth. Drill three holes for riveting on the legs and file notches for the three cigarette rests.

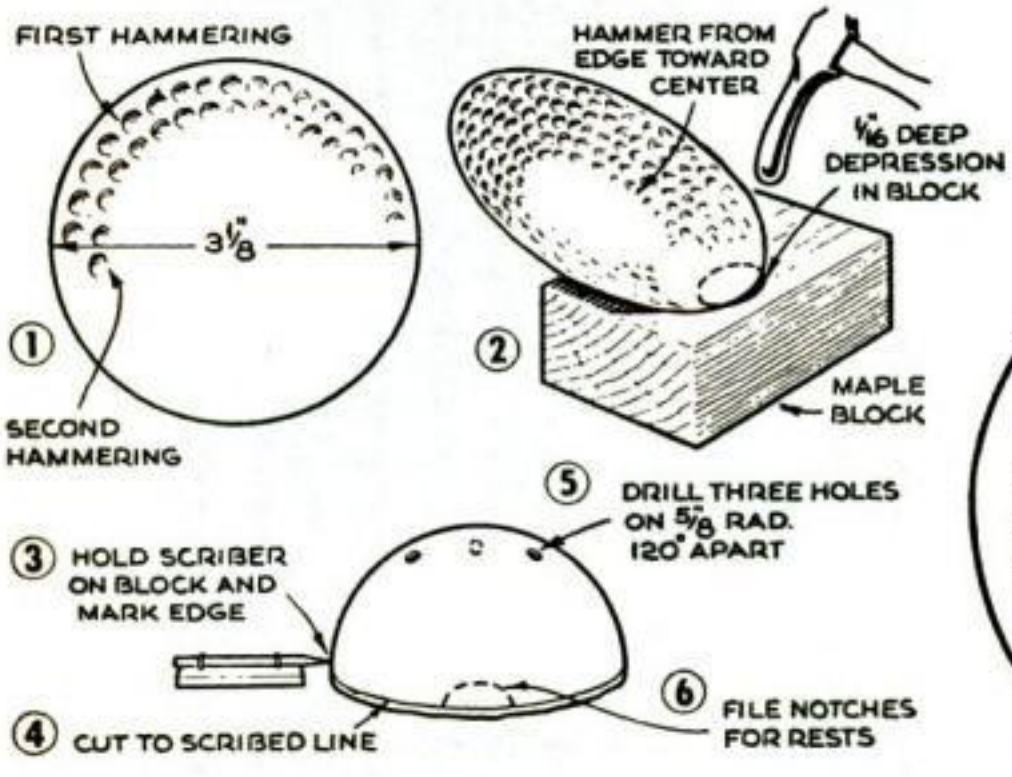
Cut out and shape the legs, rivet and solder them on, cut and shape the rests, and solder these in place. Polish and lacquer the piece.—H. W.

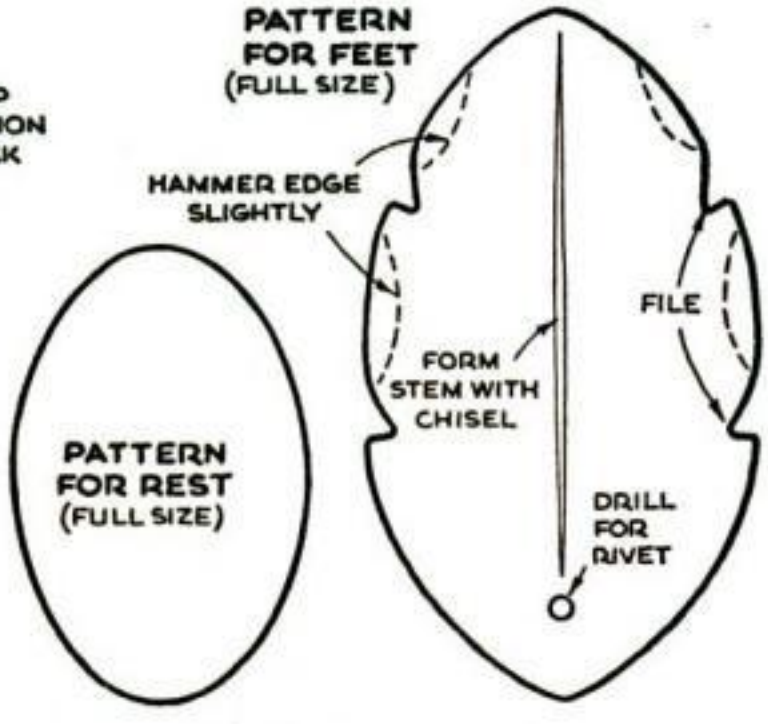
## Planishing Stake Is Made from Railroad Spike

Bring home the next discarded railroad spike you find lying along a right-of-way. You can cut and grind the head, as shown in the drawing, to make a planishing stake for hammering bowls too small for the usual planishing stake. The head should be spherical when you have finished grinding. Smooth with a fine file and polish with emery cloth. If the stake slips in the vise, notch the shank.—H. W.



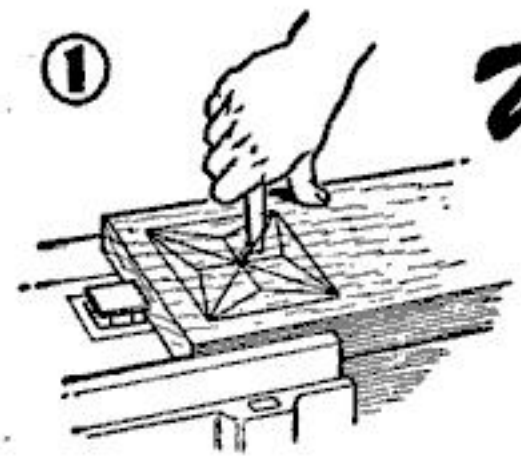




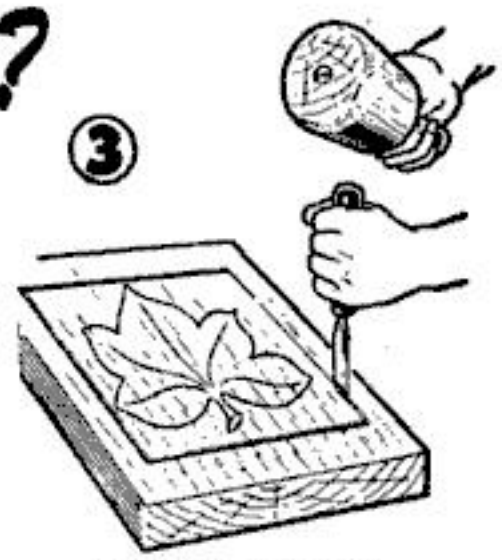

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# What's Wrong?

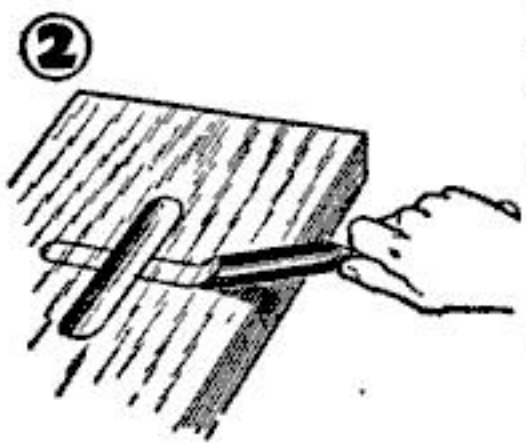


STARTING A POCKET IN A CHIP CARVING

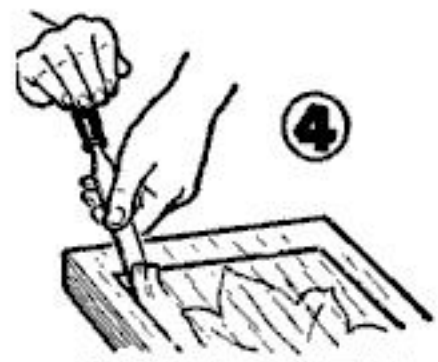
ANYONE who followed the recent series on wood carving in POPULAR SCIENCE can find these seven errors. Turn the page upside down to check your answers with those below.



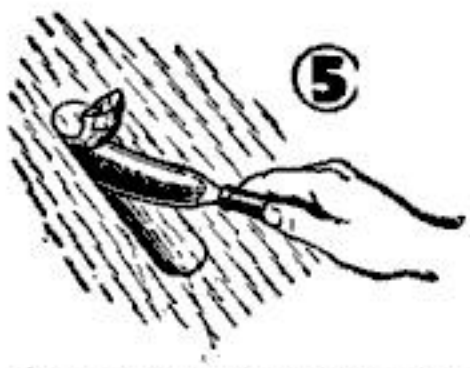
FIRMING IN THE OUTLINE



CUTTING CROSSED FLUTES WITH A GOUGE



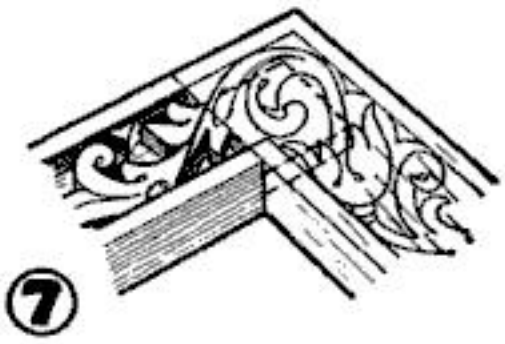
ROUTING OUT THE BACKGROUND



FINISHING THE ROUNDED END OF A FLUTE



VEINING A LEAF IN AN UNFINISHED CARVING



A TENONED-FRAME CARVING WITH A ROUTED BACKGROUND

ANSWERS: 1. Stop cuts should be stabbed with the knife truly vertical, and should raise no chip.

2. Cut the first flute across grain so the gouge won't splinter the edge when it is being crossed.

3. Place the chisel 1/32" to 1/16" inside the line to allow for crushing and the trimming cuts.

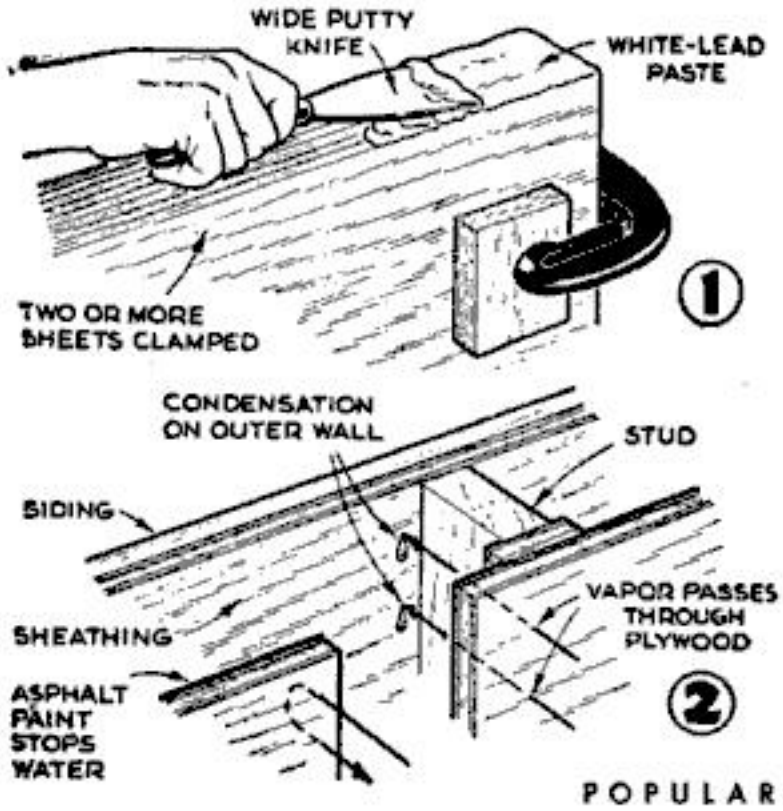
4. Use a gouge for rough routing. A chisel should have the bevel on the underside.

5. Cut flutes toward the center from both ends.

6. Instead of finishing one part completely, firm in the whole carving, and then boat it, carrying each stage over the whole piece.

7. This style is too deep for the frame. It will cut into the tenon.

## MOISTURE-SEALING PLYWOOD [WOODWORKING]




**Condensation control.** During cold weather water vapor inside a room passes through plywood wall lining and condenses as moisture against the cold outer sheathing or siding. Especially in homes heated by gas, sufficient moisture may collect inside the wall to drip, sometimes wetting mineral wool or other insulation and nearly nullifying its insulating value. This is largely prevented if two coats of asphalt or aluminum paint are applied on the backs of the panels before installation. (Fig. 2). Glossy-surfaced asphalt-impregnated paper weighing 50 lb. per 500 sq. ft. is nearly as effective. Outer sheathing or siding should not be backpainted, for this further retards passage to the outside of any water vapor that might pass through the inner panels. Ventilation is an aid in condensation control.

**Edge sealing.** Plywood exposed to weather or humid conditions should be edge-sealed, as in Fig. 1, by application of white-lead paste or a suitable resin paint.

**Exterior surfaces.** Exterior plywood may be obtained ready-sealed, or it may be sealed with ordinary resin sealer. Standard painting practice, such as three coats of good-quality outside oil paint, is suitable. Textured finishes compounded of asbestos and silica with resin-base paints are also serviceable.

POPULAR SCIENCE MONTHLY SHOP DATA



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Having a coal mine in his back yard (see PSM, Jan. '46, p. 146) W. B. Swope didn't have to worry about getting fuel up the long hill, left, from the street to his house. When the mine ran out, he built a cable hoist capable of carrying 600 lb. at a time.

## Cable Hoist Carries Coal to Inaccessible Mountainside Home

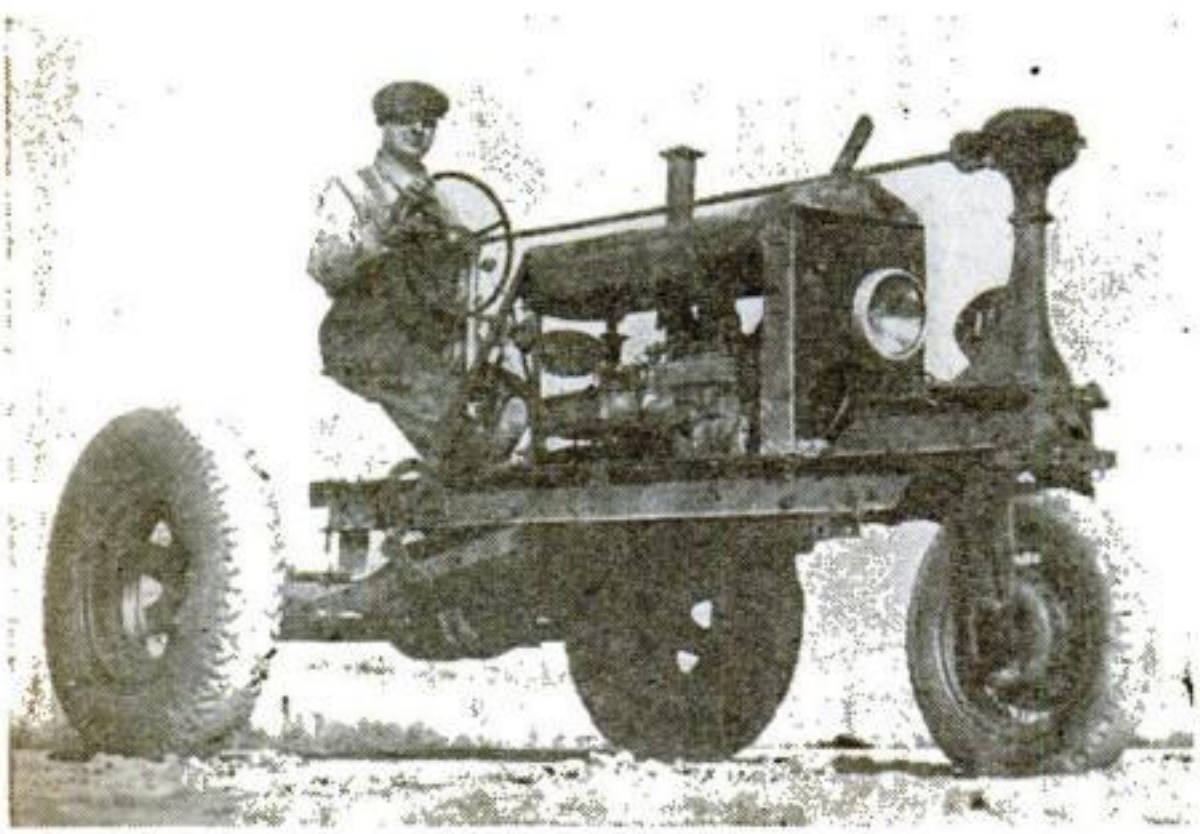
IN MOUNTAINOUS Welch, W. Va., a small army of carriers was needed to haul a season's supply of coal 400′ up a steep mountainside from the street to the home of W. B. Swope. The pictures above show the hoist that Mr. Swope installed to solve his carrying problem.

Traveling on an incline down the hill, the bucket hits a stop and drops into the truck. After filling, the bucket is lifted out of the truck by a double-groove snatch block, and then engaged on the carrier cable for the long ascent. A four-man crew can move two tons an hour. The hoist also comes in handy for carrying furniture, groceries, and other heavy loads to the house.

## Farmer Builds Tractor from Old Automobile and Truck Parts

SHORTAGES of almost everything except automotive junk and ingenuity led Albert B. Mrachek, of Alexander, N. D., to combine the two things he had plenty of. The result is this versatile three-wheel tractor, capable of pulling two plows, cultivating grain, or moving quantities of soil.

If the machine could trace its assorted ancestry, it would name, among others, a Universal tractor, a Whippet truck, a Chevrolet, and Ford cars from T to V-8.—LEO HARRIS.



**ANSWERS TO CAR QUIZ**
*on pages 112-113*

1. Nash; 2. Packard; 3. Ford; 4. Fooled you. This exists only on paper. 5. Pontiac; 6. Hudson; 7. Studebaker Skyway Champion; 8. Chevrolet; 9. Kaiser; 10. Willys "Jeep;" 11. Mercury; 12. Chrysler Royal.



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# the right Kodak Film

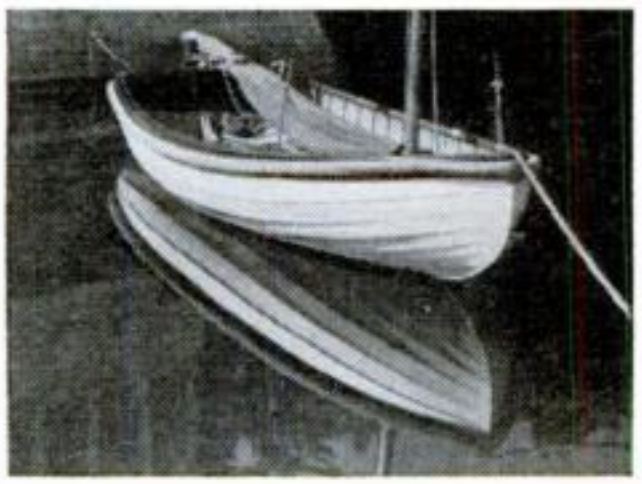
**This summer you'll again have a wide choice — *for example* . . .**



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**KODAK PLUS-X** (rolls, packs) — all-round "pan" film; combines high speed, fine grain.



**KODAK PANATOMIC-X** (sheets, miniature rolls) — extremely fine grain, for *big* enlargements.



**KODAK SUPER-XX** (rolls, packs) — favorite high-speed film for both outdoors and indoors.



**KODAK TRI-X PANCHROMATIC** (sheets) — very fast; excellent when exposures must be short.



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Those which "stay home"—the rejects—are the few which fail to pass the score or more of meticulous tests and inspections that guard the various manufacturing stages.

The testing operation illustrated above is one of many. Here, triangular files are being checked, one by one, with a dial gauge to see that edges are uniformly correct in width.

The mechanic who asks the boss for Nicholson or Black Diamond brands shows that he knows files—and, most likely, that he is a worker of high talents.

***FOR REPAIR SHOP, HOBBY SHOP, HOME OR FARM,*** *get Nicholson or Black Diamond files from your hardware dealer. For information on kinds, use and care of files send for free book,* **"FILE FILOSOPHY"***—48 interesting illustrated pages.*

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**NICHOLSON FILES** *FOR EVERY PURPOSE*


# GRAVEST ILLNESSES are tasks for atomic research

(Continued from page 96)

often than not they are low; the build-up of radioactivity in the feet is too slow. The curves, of course, do not present a complete clinical picture. The counts may be deceptively raised, for example, by such conditions as fluid in the tissues (edema or dropsy), even though the circulation has actually been impaired. The physician has to interpret the findings. But the technique gives him an impersonal assessment of the circulatory situation, and thus represents an important advance in the handling of a group of painful, disabling, and often fatal conditions.

In another form this technique has been developed at the University of California for the diagnosis and study of vascular diseases like hardening of the arteries, trench foot, and Buerger's disease. Tracer studies have been made on experimental animals, which were allowed to breathe krypton, one of the "noble" gases—so called because they form no compounds. The gas had previously been rendered radioactive in the cyclotron. The build-up of radiation in the extremities was measured with the Geiger counter. The effect on the circulation of drugs such as adrenalin and histamine has also been studied.

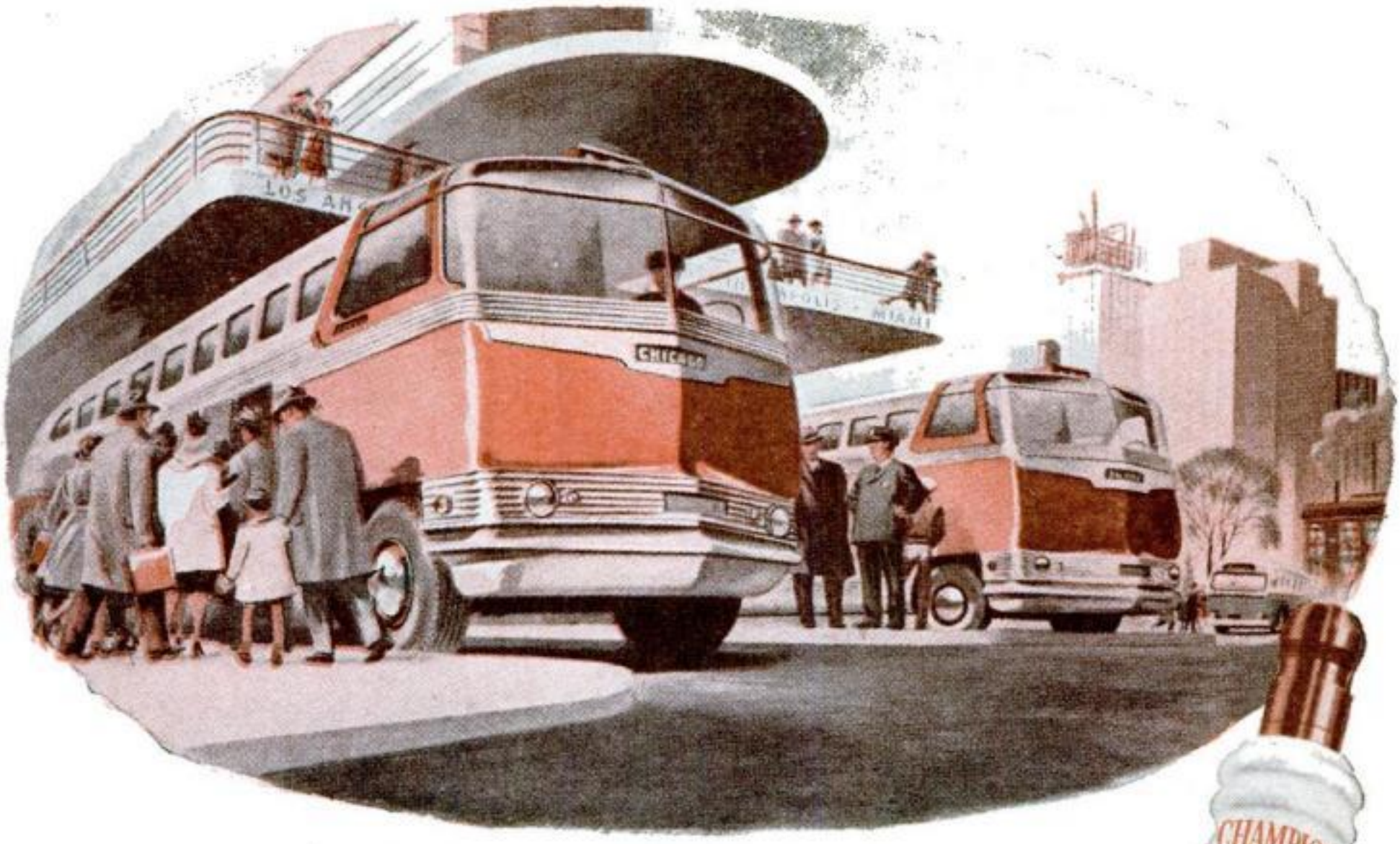
If the leucocytes or white corpuscles of the blood get out of control, a person may suffer from leukemia. It is a circulating form of cancer. Leucocytes are necessary; they fight infection and have many other important and complex regulatory functions. But not many are necessary; in normal blood there is only one white corpuscle to every 500 or 1,000 of the red. In leukemia, the white cell count increases out of all proportion, and at the same time the cells fail to mature properly. The blood can no longer do its job of nourishing and repairing the tissues and carrying off their waste products. It is as if the military police set out to run the army. Acute leukemia is very difficult to control. In chronic leukemia there is more hope, but nothing that can be called a cure has yet been found. Benzene and arsenic have been used, but in recent years the principal reliance has been on X-radiation. This usually dampens the exuberance of the leucocytes, but eventually the dosage required is so high that the body can no longer tolerate it. The physician has to steer a precarious course. With proper dosage, however, the span of comfortable

(Continued on page 214)



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# Why Bus Lines specify Champion Spark Plugs




## THEY'RE DEPENDABLE!



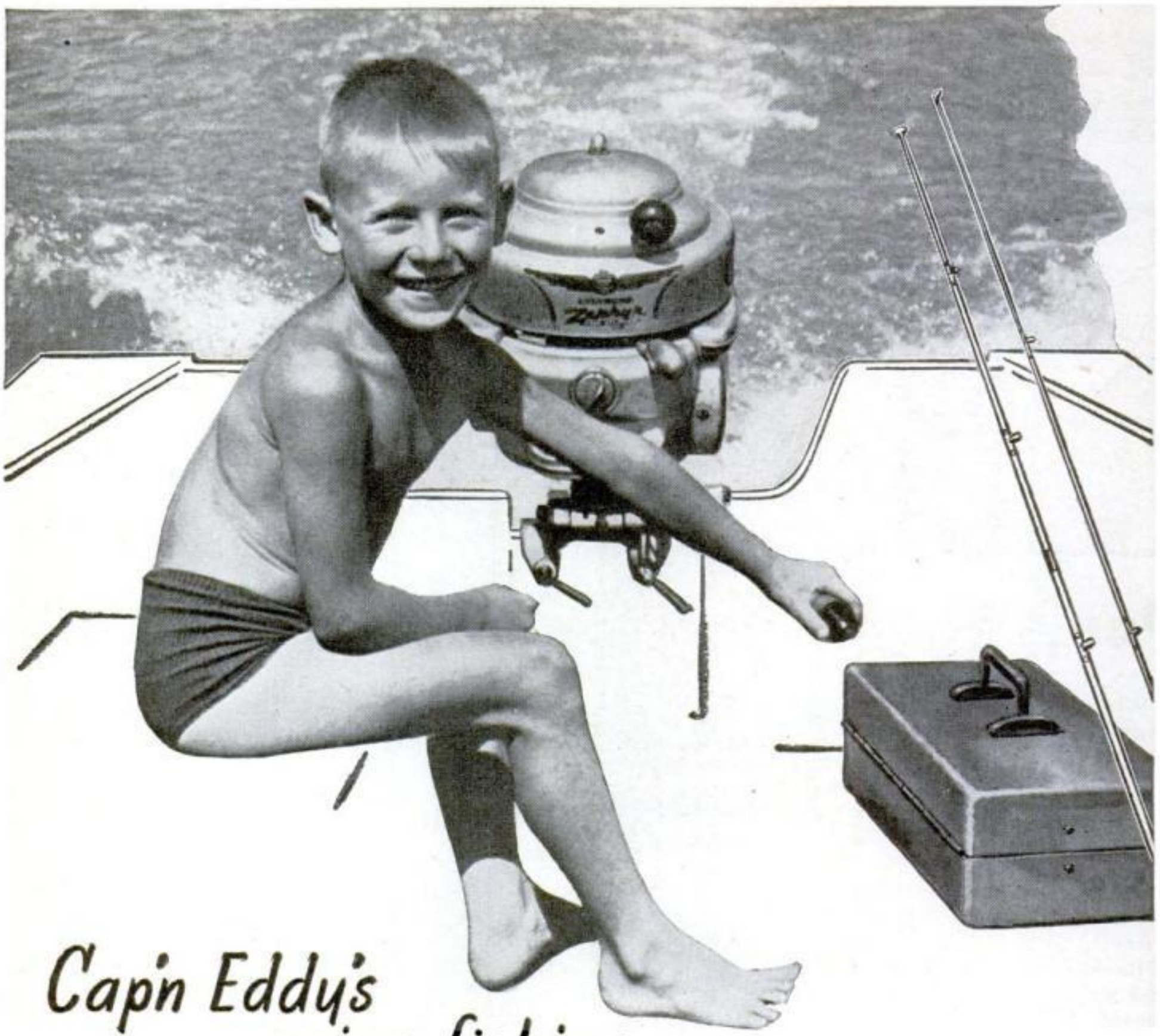

**The bus lines of America are indispensable to our transportation system. They are experts on maintenance of equipment because efficiency and economy are absolute essentials to success in their business—no factor is too small to escape detailed study. That is why most bus lines with the best maintenance records specify dependable Champion Spark Plugs. This is another example of preference for Champions by experts—substantial evidence that they're better for your car. Champion Spark Plug Company, Toledo 1, Ohio.**



**FOLLOW THE EXPERTS . . . DEMAND DEPENDABLE CHAMPIONS**



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# Cap'n Eddy's going fishing . . . .

Cap'n Eddy may seem a bit youthful to be skippering all that horsepower! But Eddy agrees with his dad . . . it's a sound idea to start 'em young!

So Eddy is "an old hand" with Evinrudes, and revels in all the pleasures that go with them. A lot of happy miles have foamed in his wake, he has baited many a hook and "boats" his fish like an old-timer.

In thousands of family albums there are snap shots such as this one of Eddy*. Photographs of children running Evinrudes capably, easily, joyfully.

Each picture is a forthright testimonial to an Evinrude quality that users prize above all others.

*The assurance of carefree performance,* even in a youngster's hands. *Performance* that has been perfected step by step during 36 years of building fine outboards . . . trustworthy *performance* that is mechanically *built right in,* ready to go and *keep on going!*

It's waiting for you — see your Evinrude dealer! Look for his name under "Outboard Motors" in the classified section of your phone directory. Write for catalog of the complete Evinrude line. Address, EVINRUDE MOTORS, 5266 North 27th Street, Milwaukee 9, Wisconsin.

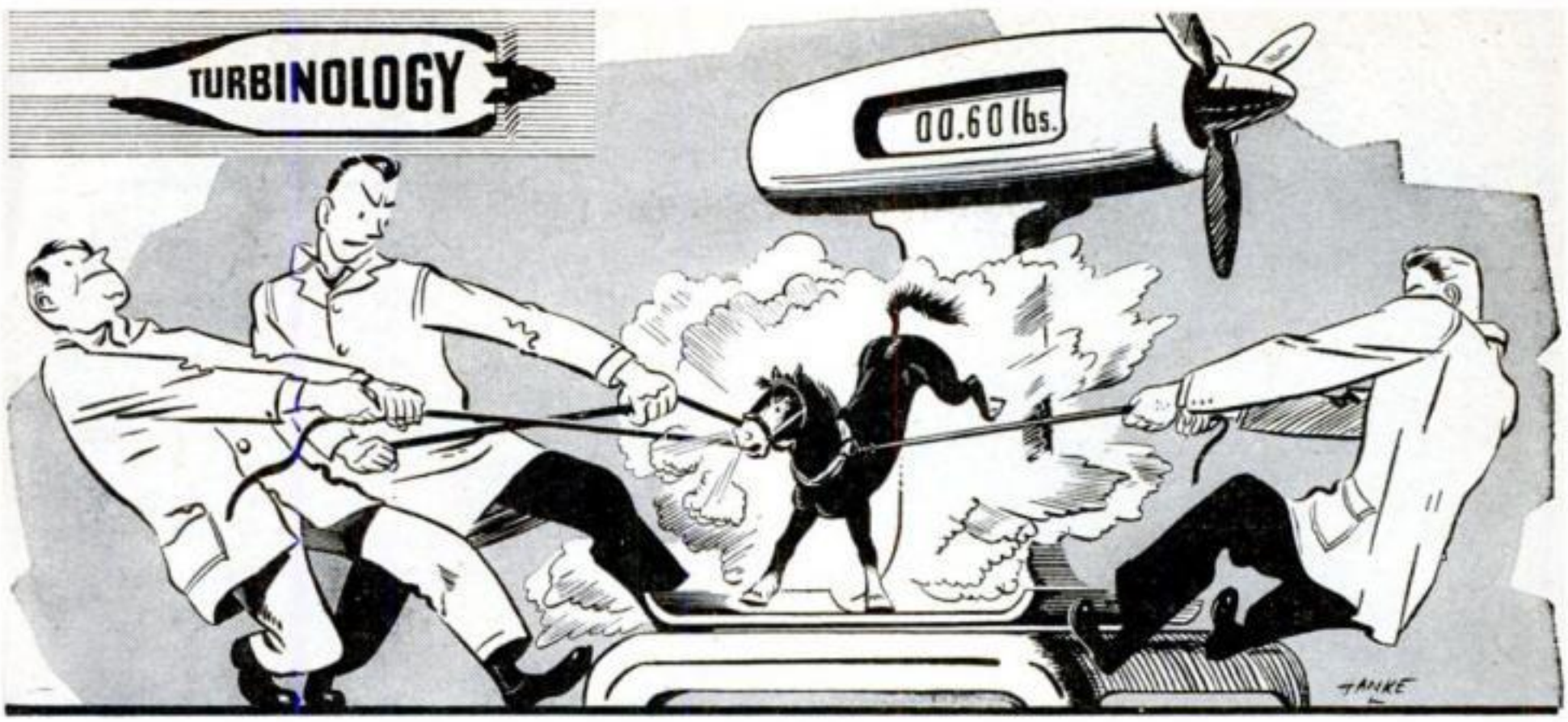
*In Canada, Evinrude Motors, Peterboro, Ontario.*

*Eddy Ogrodowski of Toledo, Ohio.*

**EVINRUDE**
OUTBOARD MOTORS



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# Pony-Weight Horsepower

When a plane is described as being 200,000 pounds in gross weight, this figure includes not only the weight of the plane but all of its load of gasoline, oil, crew, passengers, mail, and cargo.




If the plane structure is "heavy", the useful load is light. If its engines are gas hogs, more fuel and fewer passengers go aboard. And if the engines are heavy for the power they deliver, still more potential load remains on the ground.

The champion of all reciprocating engines for weight-per-power is the Cyclone 9, first engine to weigh less than a pound per horsepower. It delivers 1,425 horsepower but weighs only 1,352 pounds, or 0.95 of a pound per horsepower. Most engines run over a pound per HP, especially in the high output types.

Now there is another champion, in a new power field. The Wright propeller turbine has made the sharpest of all cuts in weight, while at the same time doubling the power of the Cyclone types. Within a short time, Wright turbines will deliver many times the power of the Cyclone 9 at a weight of only 0.60 of a pound per horsepower. It will make a difference of hundreds of thousands of dollars in airline revenue and will mean lower passenger fares and cargo rates.

On a two-place training plane, the difference between 0.95 and 0.60 of a pound per HP is not a major one. Maybe about a dozen pounds. But on the new air giants taking off with as much as 30,000 HP, the difference is tremendous. A plane with this much power from ordinary type engines would have to carry over 30,000 pounds in engine weight. But Wright turbines of equal power, would only weigh 18,000 lbs.




Much of the weight saving in the Wright turbine comes from its sheer simplicity. There are just two main moving parts: the air compressor and the turbine wheel, plus gears to slow down the turbine speed to efficient propeller speed. Eliminated are the individual cylinders, pistons, valves, connecting rods, crankshafts and counterweights, cams and intricate gear trains. In the four Cyclones of a B-29, there are 144 spark plugs while the turbine has but three per engine.

The turbine is well balanced and needs no counterweights. Turning continuously, with no pistons moving up and down, it does not set up strong vibrations and thus uses a lighter housing than engines of equal power.




These figures on weight savings, and what they mean in terms of payload, are only one of the reasons why the giant planes to come are being designed for Wright propellor turbines. And these figures are just one more indication of the way Wright Aeronautical engineering produces better aviation power for all types of aircraft.

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**AIRCRAFT ENGINES**
DIVISION OF
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*Home Craft*

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# GRAVEST ILLNESSES

## are tasks for atomic research

and active life can be considerably extended.

Radiophosphorus was first tried in 1936. Much of the work in this field has been done at the University of California by Dr. J. H. Lawrence and his co-workers. (Don't confuse Dr. J. H. Lawrence with his brother, Dr. E. O. Lawrence, the cyclotron man, of the same institution.) The idea was to get a radioactive substance into intimate contact with the rampant leucocytes, so that they would be strongly irradiated, the rest of the body less so. The results are about equivalent to those secured with X rays.

More recently radiosodium has been substituted for phosphorus. Radiosodium expends its energy in about as many hours as radiophosphorus takes days, and on this account dosage is more readily controlled. The results have not yet been reported, but at any rate one more radioactive substance has reached the therapeutic stage.

Another disease, *Polycythemia Vera*, is leukemia in reverse; it is the red cells that get out of hand. Radiophosphorus also has been used in its treatment. The results have been distinctly encouraging, but since the disease is rare not many cases have been treated.

We can usually cope with disease caused by invasion of the body, or failure of some organ to do its job. At least the problem is specific: kill the invading agent, supply the deficiency. In cancer the strategic situation is less favorable. Cancer is not war, but revolution. It may be regarded as a kind of perversion of a process necessary to life, the process of growth. Cancer cells are different from normal cells, but the two resemble each other more than they differ. Normally there is some control, the nature of which is still obscure, which keeps the cells growing at the right pace and in the right places. When this control fails in a particular organ or tissue, we have a tumor of *neoplasm*. If the tumor is malignant, capable of spreading or *metastasizing*, then we have cancer. But the opposite number of cancer is not normal growth. It is the death of tissue through inability to multiply and maintain the physiological status quo. Health consists in maintaining a balance between the two extremes.

It is highly improbable that we shall ever achieve a cancer "cure" in the medically illiterate layman's sense of something that comes in a bottle. But this does not mean

(Continued on page 218)



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# How to CHANGE A TIRE AT NIGHT...

## *More Quickly—More Safely!*





**1** Most any motorist can change a tire. But few can change it at night with top speed, efficiency —and *safety!* Night-time tire-changing can be hazardous — but a little care and an "Eveready" flashlight can reduce the danger. First principle, says the American Automobile Association, is . . .

**2** Park *off* the highway, if at all possible. Next best place is on a *straight* stretch of road where you can be seen for at least 500 feet. If you *must* park on a curve, a light should be set on the road some distance back. Be sure neither you nor a bystander blocks off the view of your tail-light!



*For*

**EXTRA POWER, EXTRA LIFE —AT NO EXTRA COST**




**3** Keep all your tire-changing tools tied or boxed *together,* where you can pick them up without searching or fumbling. Remove your spare before jacking up car — tugging at it later might push car off jack. If alone, set flashlight on a stone in convenient position.

**4** In your car or at home—wherever you need a flashlight—rely only on "Eveready" batteries. For "Eveready" batteries have no equals . . . that's why you'll find them in *more* flashlights than any other battery in the world! Now that they're available again, there's no need to accept a substitute!

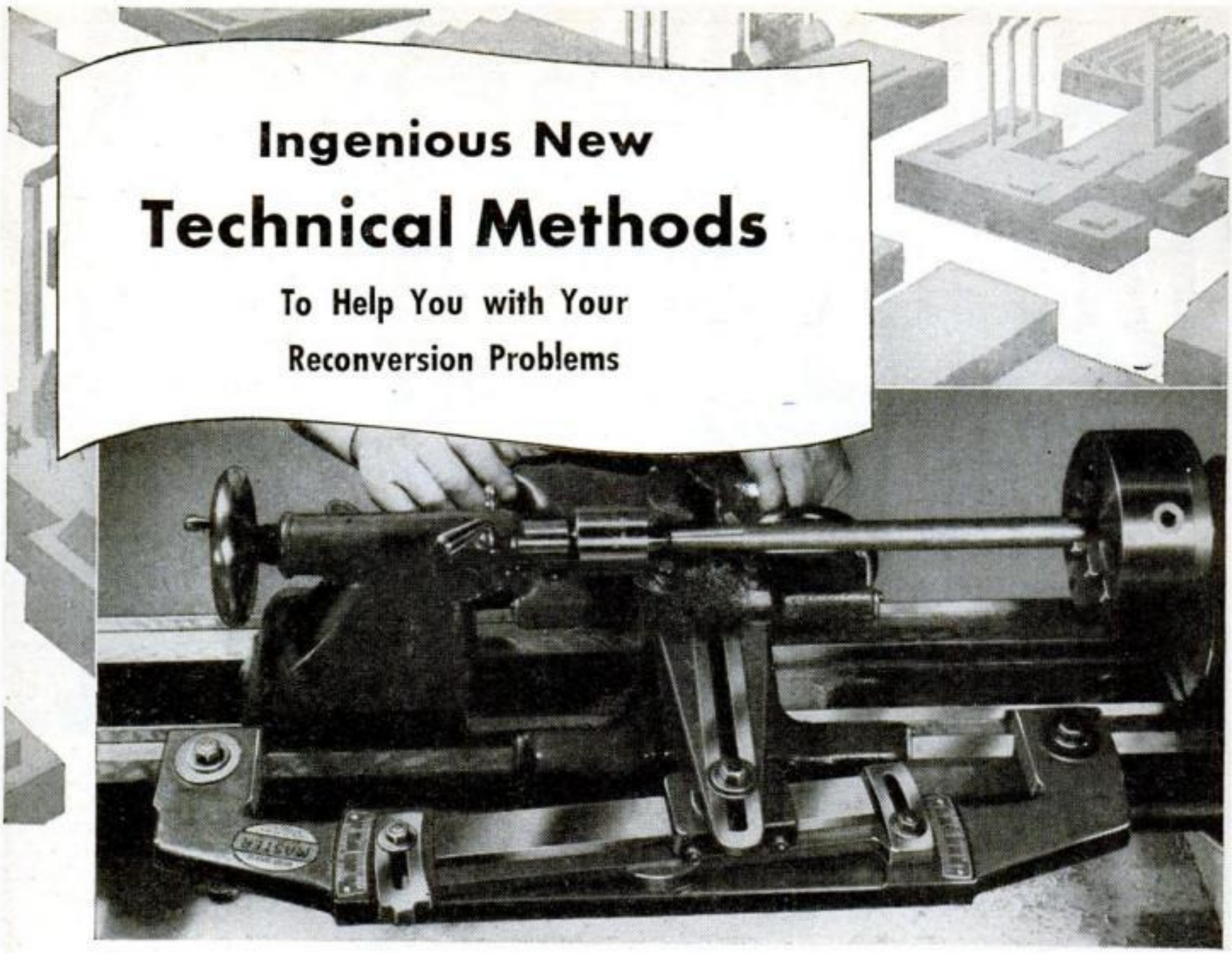
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# Simplified Master Taper Attachment Fits All Types of Lathes Instantly!

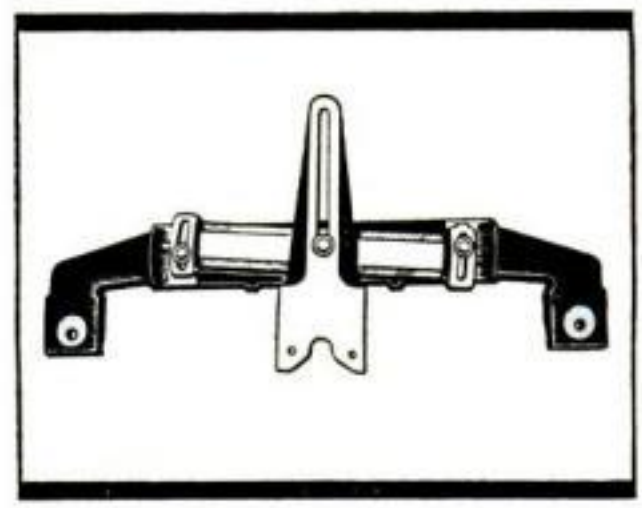
**Now! A "universal" taper attachment** that fits all lathes, old or new, big or small—that can be attached or removed in *minutes!* This taper attachment is not bulky or cumbersome. It bolts easily to the bed, in the back of any lathe.

**The Master** performs accurate taper turning, boring and threading with the ease of any straight line tool operation. It precisely duplicates any tapered part. Is usable in any position. Does not interfere with straight turning. The bar is precisely machined and fitted. There is no vibration. Taper graduations are in inches at one end; degrees at the other. The Master is available now, in two sizes; two feet and four feet in length.

**Available today** also, is delicious Wrigley's Spearmint Gum. This is one treat you can enjoy even when your hands are busy. And the pleasant chewing helps to keep you alert and wide-awake, even through a monotonous job.

Chewing Wrigley's Spearmint satisfies a fellow. In addition, it helps keep your mouth moist and fresh—so you feel better. And feeling better, you naturally work better. By making chewing gum available to all, scores of plants and factories report increased morale and efficiency that really pays off.

*You can get complete information from the Keene Electrical Machinery Co. 549 W. Washington Blvd., Chicago 6, Ill.*



**Model 710 Master Taper Attachment**




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Aeronca has built a new plane, designed for average people. It has made flying simple—*and economical!* It's so easy to fly . . . thousands learn to fly solo in 8 hours or less. It brings plane ownership within reach of thousands who have never flown before. Two thrilling new Aeronca models are now in production. Both offer new room, comfort and luxury. Many extra value features you won't find in other planes at Aeronca's price. See your Aeronca dealer.

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# GRAVEST ILLNESSES are tasks for atomic research

that we are utterly helpless, or that atomic medicine holds out no hope. It does—but not tomorrow or the next day. How much time depends on whether we continue cancer research on what Dr. Shields Warren has aptly called a "shoestring scale," or pour real money, manpower, equipment, and effort into the job.

The atomic methods currently used in cancer therapy are: 1) External irradiation, in the form of regulated exposure to X rays, or other radiation from sources outside the body; or from a foreign body, such as a needle or capsule containing radioactive material, which is implanted in the tumor or placed in a body cavity; )2 Internal irradiation by administration of radioactive material that may be absorbed organically by cancerous tissue, which will thus receive radiation at the closest possible range. The first is by far the most important now; the other is still experimental.

Recent research has not contributed anything startling to external irradiation. We have new and largely untried forms of radiation, neutron streams in particular, but no proof yet that they behave radically different from X rays. *If* we could find a form of radiation that would damage all malignant tissue and spare all normal tissue, that would be the answer. Failing that, we must resort to what amounts to differential damage. Fortunately there is a tendency for malignant tissue to suffer more than healthy tissue under bombardment, and where this difference is appreciable radiation therapy is proportionately effective.

There is always the chance that among the various particles that we are learning to direct and control, something will be found that will give a significantly better differentiation. One way of accomplishing this would be by concentrating the energy of the radiation in depth through a sort of focusing action. Dr. G. Failla of the College of Physicians and Surgeons of Columbia University expects substantial improvement in the treatment of deeply located internal cancers with X rays generated by the high-energy electrons of the betatron.

The betatron is an electromagnetic device somewhat like the cyclotron, but it operates on A.C. instead of D.C., accelerates electrons instead of heavy positive particles, and works at much higher speeds. It is capable of generating X rays of voltages as high

(Continued on page 222)



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"Switch to Auto-Lite
. . . money cannot buy
a better spark plug"
*Dick Haymes*

"They put a song
in the heart
of your engine"
*Helen Forrest and
Gordon Jenkins*




*The Spark Plug that's Ignition Engineered*

**TREAT your engine to a new set of Auto-Lite Spark Plugs, ignition engineered for today's gasoline. If your spark plugs are faulty, you will restore gasoline mileage, get faster starts, smoother operation. And when so many of the nation's leading car manufacturers specify Auto-Lite Spark Plugs as original factory equipment, you can bet Dick Haymes is right . . . "Money cannot buy a better spark plug." So see your friendly Auto-Lite Spark Plug Dealer today.**



Auto-Lite Spark Plugs are ignition engineered. They're designed by men who have designed complete automotive electrical systems for 35 years!

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*Switch to—*

# AUTO-LITE SPARK PLUGS

*"Ignition Engineered"*



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# YOU CAN HAVE THE WORLD'S FINEST MECHANICAL TRAINING AND EARN WHILE YOU LEARN

If you are interested in machinery and want the knowledge and experience for a lifetime career in the field of mechanics, the U. S. Army has a twofold opportunity for you.

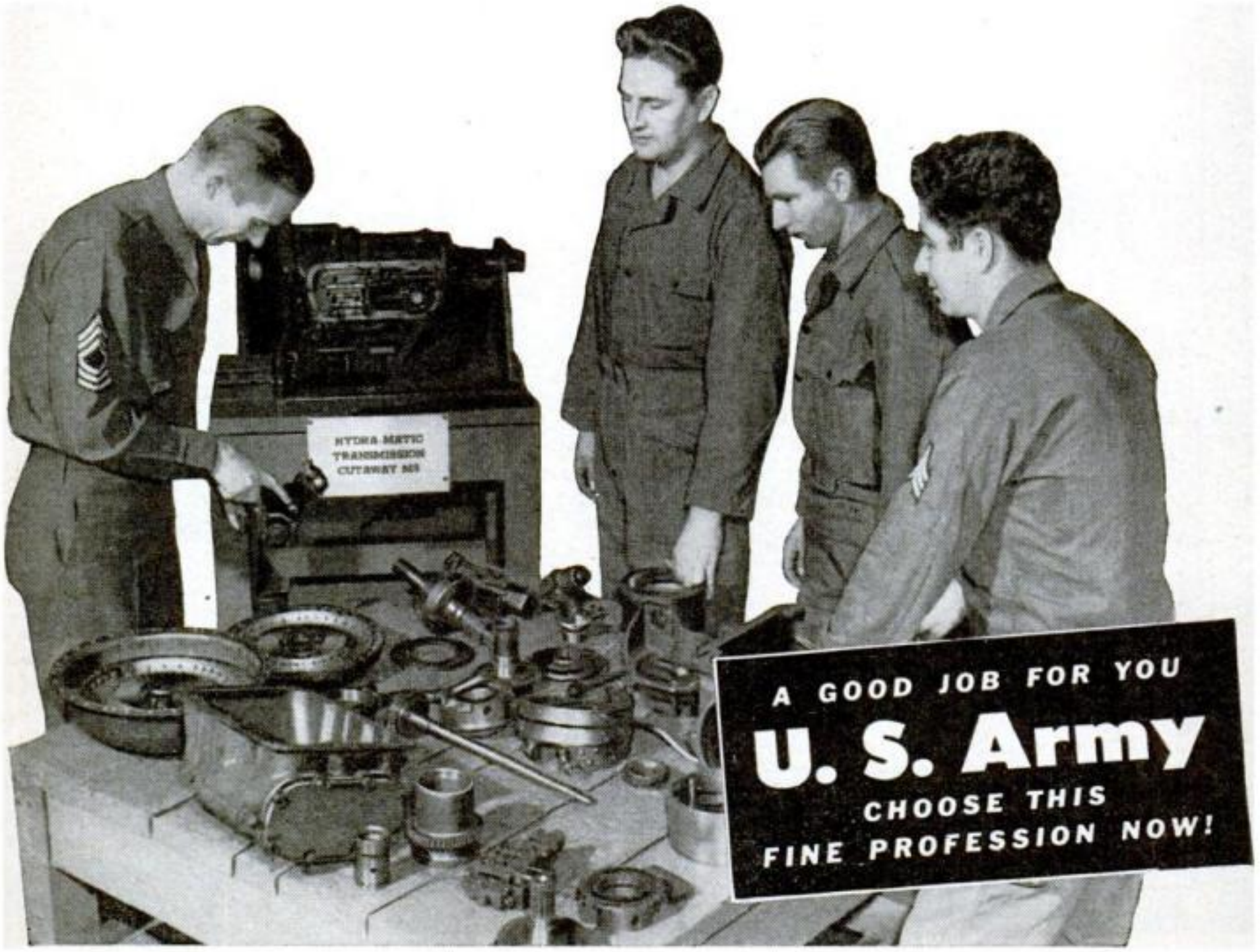
First, if you are 18 to 34 inclusive (17 with parents' consent) and will enlist now for a period of three years, you may choose to join one of the arms or services of the Army Ground Forces, Army Air Forces, or Army Service Forces, which will give you some of the best mechanical training in existence today.

You may attend one of the Army's top-flight mechanical schools, and master the technical details of all kinds of engines, including diesel, radial and internal combustion. You will be given practical experience in repairing and maintaining the Army's own fine equipment.

Second, under the GI Bill of Rights, after your discharge from the Army, you will be entitled to attend any college or trade or business school of your choice which will admit you, provided you enlist before October 6, 1946.

After a 3-year enlistment, you may have up to 48 months of education, with the Government paying your tuition and incidental expenses up to $500 per ordinary school year, and a living allowance of $65 a month ($90 a month if you have dependents).

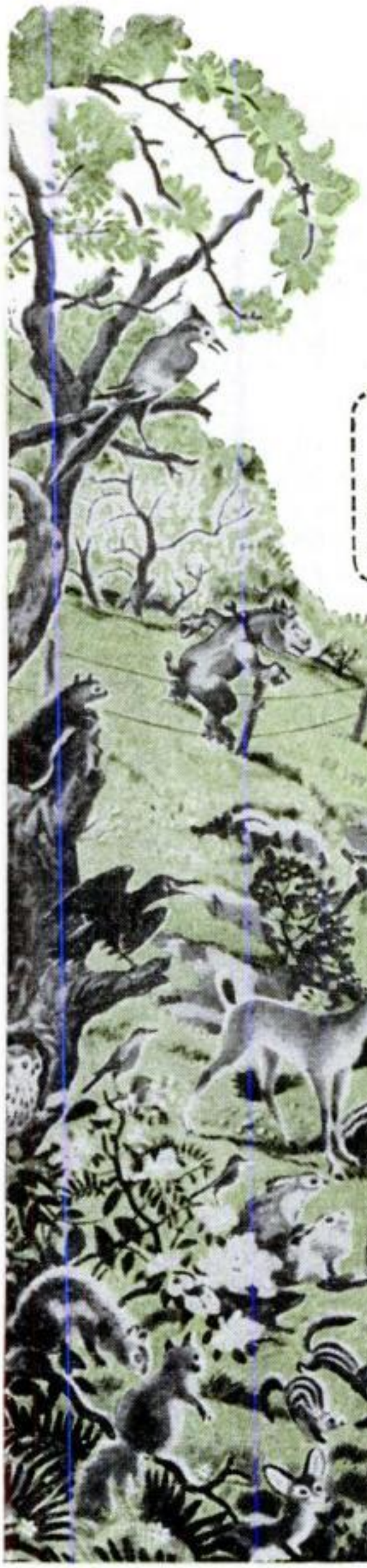
Add to this good pay, travel, clothing, food, quarters, medical and dental care and a 30-day furlough each year, and you'll see that it's an opportunity you can't afford to miss. Get all the facts at your nearest U. S. Army Recruiting Station.






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# for Power that Zooms in the spring..tra la!



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It's what you've hoped for and dreamed about—and here it is, all yours!

But before you start out, you'll want Casite in your motor, whether it's old or new. Casite tunes up older motors—restores smoothness and power. And it protects new motors during the critical break-in period.

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Millions of motorists have used Casite . . . and keep coming back for more. Put a pint in the crankcase every oil change and a pint through the air intake every three months. It's sold by service stations, car dealers and garages.

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# GRAVEST ILLNESSES are tasks for atomic research

as 100,000,000. With conventional X rays at relatively low voltages the limiting factor is damage to the skin, while with betatron-generated radiation the skin in the entrance area should receive less energy than the skin in the area where the rays leave the body. In between, the energy would be at a maximum and could be concentrated on the tumor. Damage to normal tissues would still be a limiting factor, but a greater differential effect on the cancer cells in the interior of the body could be expected.

The second general method—internal irradiation—is also active at the moment. Radium salts were tried 40 years ago, but failed because they were not absorbed by the malignant tissue. If they had been absorbed, it would have been a case of going from the frying pan into the fire: the half-life of radium is 1,590 years, and there would have been no means of stopping irradiation at the proper point. But now we have the artificially produced radioactive isotopes. Their half-lives vary from a few seconds to several months or years, giving a wide range of periods of activity. Moreover, some of these isotopes are selectively absorbed—iodine by the thyroid gland, iron by the red blood cells, phosphorus by the bones, liver, leukemic cells, and various neoplastic tissues. The possibility thus raised is as obvious as it is attractive: let the cancer absorb the appropriate isotope and burn itself up. The real stuff, of course, would be something that neoplastic tissues would absorb avidly and to which normal tissues would be impervious.

Unfortunately, it is not enough that the radioactive substance should be absorbed three or four times as much; there must be a very high differential ratio if internal irradiation is to be highly effective. The only known isotope that fulfills this requirement is radio-iodine. This is absorbed by the thyroid, or by metastasizing thyroid tissue, about 300 times as much as by other tissue. Consequently it shows promise in the treatment of cancers of thyroid origin.[1]

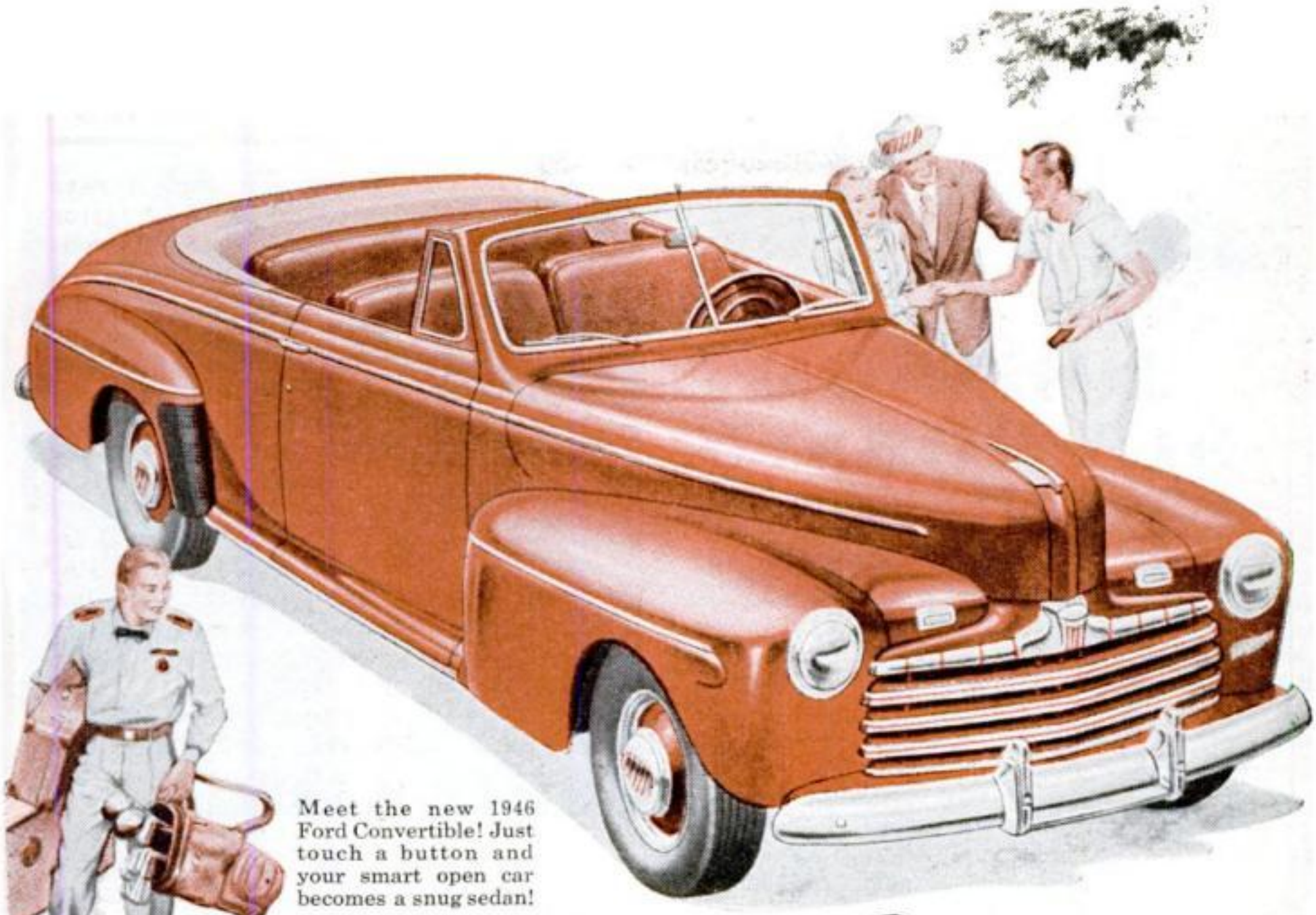
Actual progress has been slow. One reason is that radio-iodine, in particular, is extremely expensive. Ten thousand dollars was spent recently in treating one case; $4,000 in another. Yet there is plenty of radio-iodine in the country. It is being wasted up the stacks of the Manhattan Project now.

Drs. Andrew H. Dowdy and William F.

(Continued on page 226)



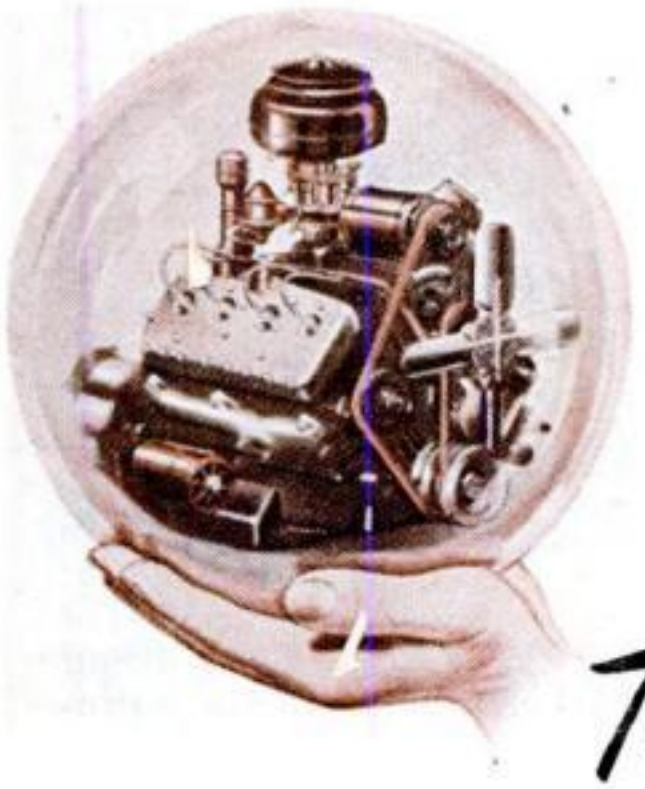
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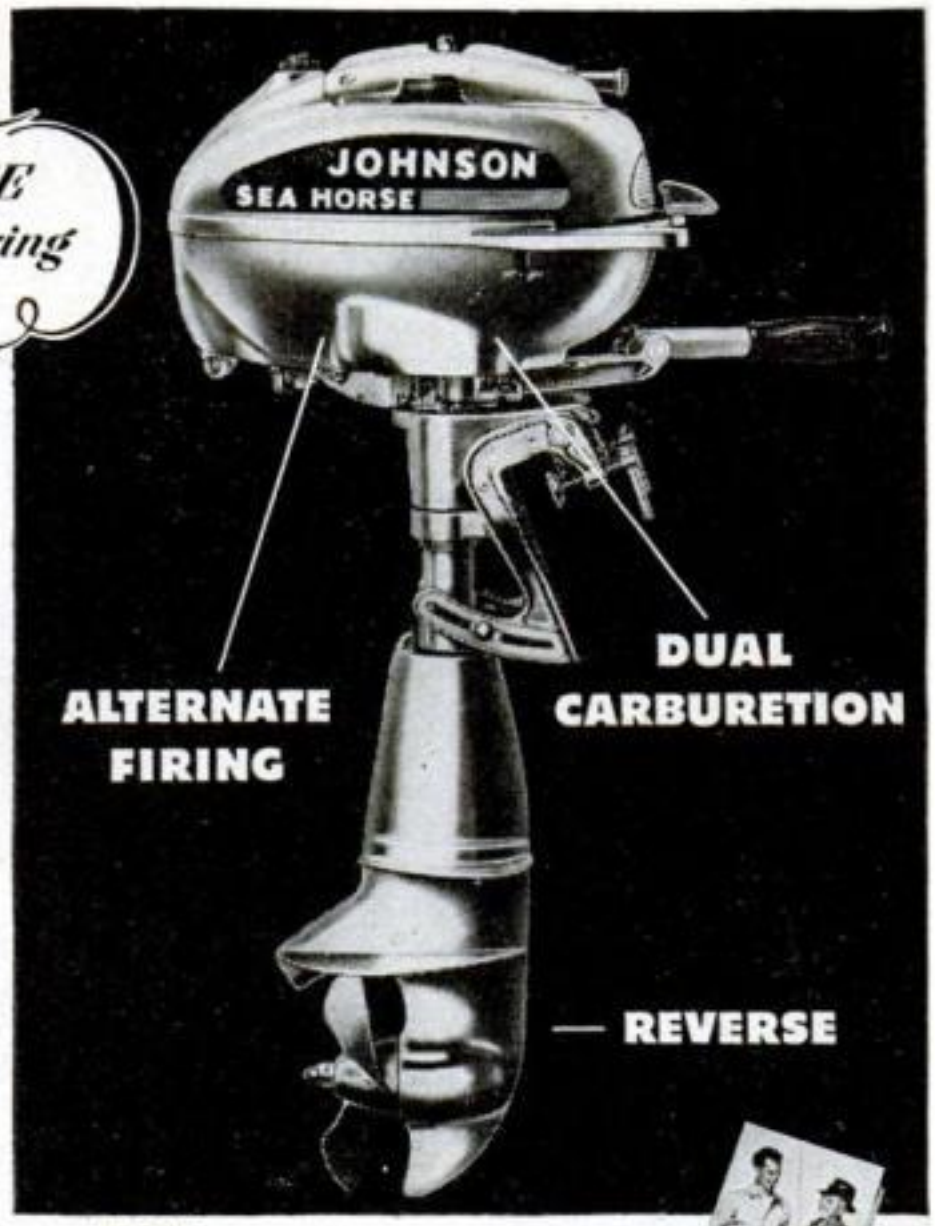
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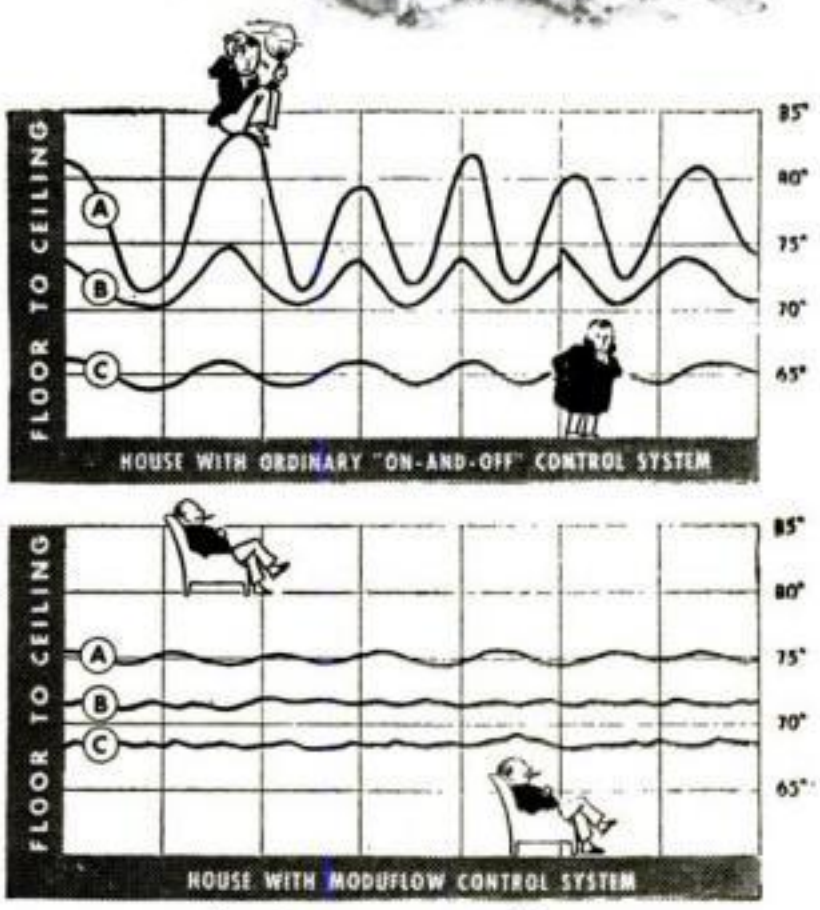
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# GRAVEST ILLNESSES are tasks for atomic research

Bale of the University of Rochester, both experienced radiologists connected with the medical department of the Manhattan Project, have recently spoken hopefully of the long-term prospects in the field of atomic cancer therapy. They do not believe that radioactive isotopes in themselves are the answer. But they do suggest that by using isotopes like carbon and hydrogen ($C^{14}$ and $H^{2}$) it will be possible to investigate many compounds, existing and to be synthesized, in an effort to find one having a high degree of toxicity for malignant cells relative to normal cells. They think a combination chemical and radiation effect may work.

Advocating Federal sponsorship of nuclear research in cancer, Dowdy and Bale sum up in these words:

"The atomic age, for better or worse, is here to stay, and, with its attendant benefits to humanity in the solution of the cancer problem, it offers both an opportunity and a challenge to medical science, to the community and the nation."

That is good to hear. Hope, after all, has its biological justification as well as its dangers. And where there is hope, there should be life enough to meet the challenge.

[1]Dr. S. M. Seidlin and L. D. Marinelli give a brief preliminary report on one case in the Bulletin of the New York Academy of Medicine, August, 1945.

---

## New Glass Absorbs Most Heat Yet It Transmits More Light

A NEW heat-absorbing, color-transmitting glass that protects films and slides from damage or burning and shields movie and television actors from the intense heat of powerful spotlights and floodlights has been developed by the American Optical Company, of Southbridge, Mass.

In movie projectors, the new glass will be used as a screen to absorb the heat emitted by the light source. It absorbs approximately 90 percent of the infra-red, or heat, radiation, and transmits about 85 percent of the light, an unusually high transmission; usually about eight percent is lost by reflection.

The new product, of which phosphorus, aluminum, and silicon oxides are the principal ingredients, is chemically stable, and can be molded, ground and polished, and fabricated like ordinary glass.



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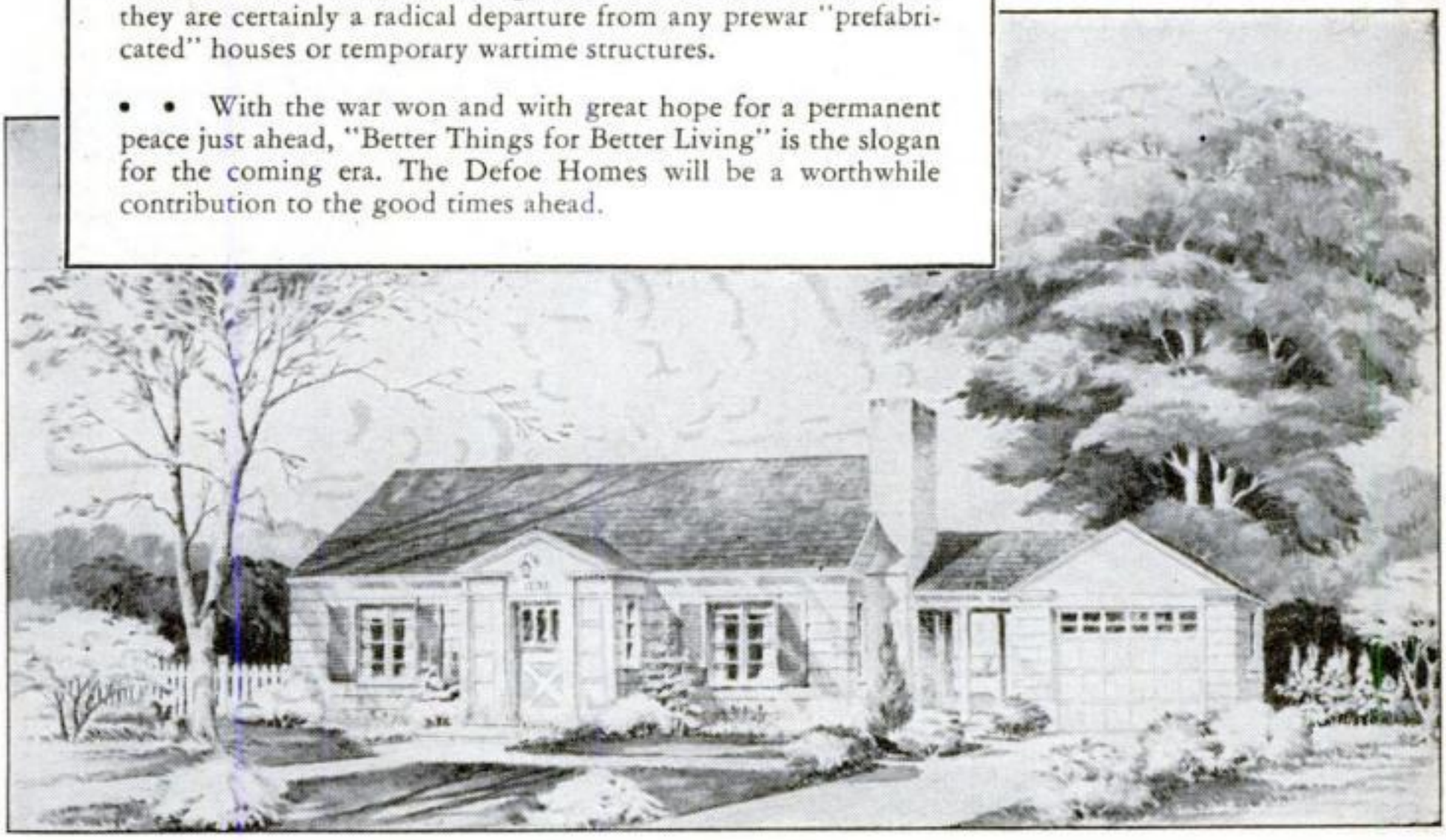
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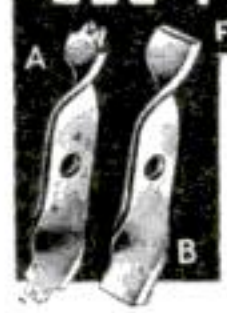



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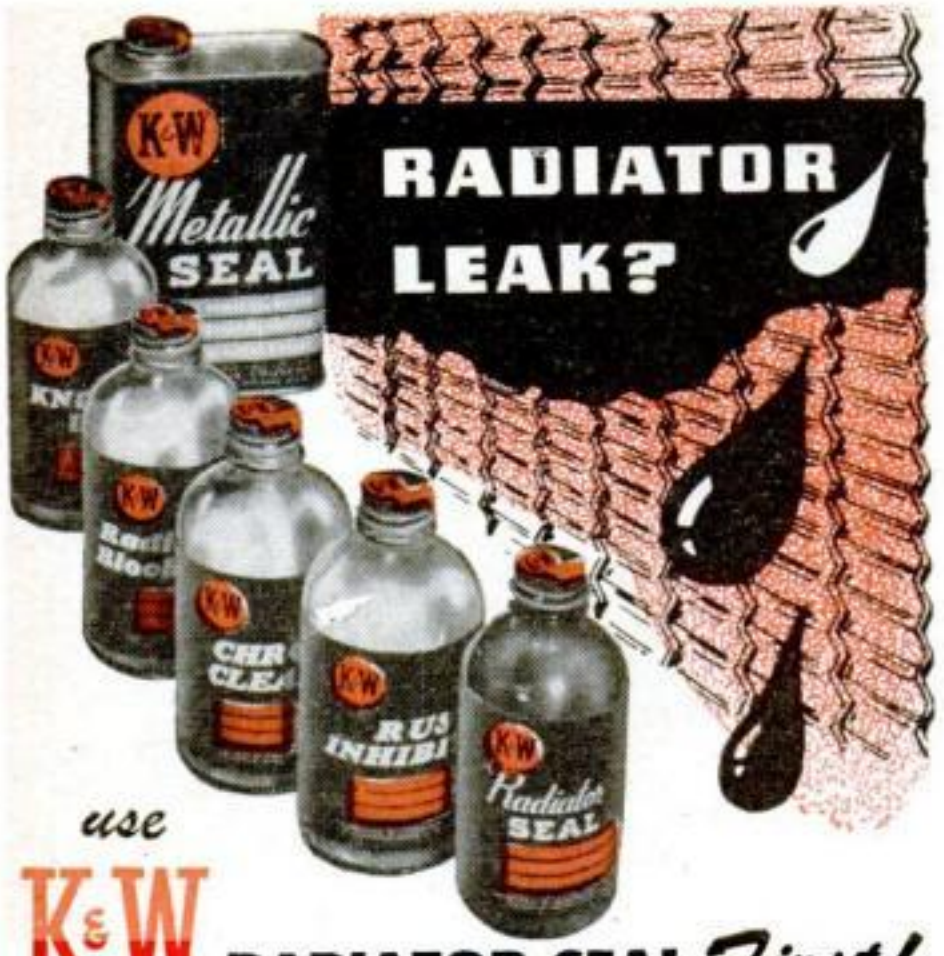

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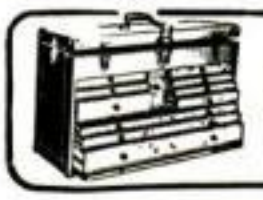



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*Let dry a minute*

WIPE OFF

*Clean 'em up Shine 'em up*

*The Quick* ZECOL *Way*

ZECOL's popularity with car owners is due to its Quality, its Quickness and Ease of Application.

Keep your car looking shiny and new. It's so easy with ZECOL. Adds a brilliant lustre to all types and colors of lacquers and enamels.

If your car has an accumulated road film, use ZECOL Scum Remover before applying ZECOL Wax.

***Ask for ZECOL*—at service stations and garages. Pints 75c, quarts $1.25, in USA.**







## ZECOL Cooling System Conditioner

Recommended to remove and prevent rust. Easy to use. No draining or flushing. Add to radiator—clean up rusty water while you drive. Lubricates water pump, bearings and seals. At service stations and garages.

**ZECOL INC.**
**Dept. 2, Milwaukee 1, Wis.**

## *CAR OWNERS . . .*




For smooth engine performance —pep and power—for stepped up lubrication—to free sticky valves —keep rings and valves free—ask for LUBAID. At service stations and garages. LUBAID Co., Dept. 2, Milwaukee 1, Wis.

*The* LUBAID *Way*

## FIX IT FAST with FENCE-MASTER

***Amazing New COMBINATION TOOL —***

***for use as:***
- SPLICER
- WIRE STRETCHER
- WIRE CUTTER
- STAPLE PULLER
- HAMMER
- PLIERS





**$6.50** POSTAGE PAID

**for . . .**
- HOME AND WORKSHOP
- FARMS AND RANCHES
- GARAGES
- MACHINE SHOPS
- SERVICE STATIONS
- ELECTRICAL INSTALLATION

## *REPLACES A WHOLE KIT OF TOOLS*

A combination tool that displaces a whole work-kit and has a thousand-and-one different uses. Splice a fence, mend a clothes-line, stake up a tree and FENCE-MASTER fixes it right . . . simply and easily.

It's so light you can carry it anywhere (1½ lbs.) — in tool box, pocket, saddle-bag or car compartment . . . an all-purpose tool ready to handle almost any emergency.

Overall length: 10¼", rust-proof finish of heat treated, drop forged chrome-molybdenum steel.

Sent to you postage paid for only $6.50.

**PLASTIC MOLDED PRODUCTS, INC.**
*(Metals Division)*
1235 West Sixth Street, Dept. PS-5, Los Angeles 14, California

**WRITE For FREE Literature**



THE RITE-WAY MOWER ATTACHMENT

## BUILD YOUR OWN POWER LAWN MOWER

**WHY BREAK YOUR BACK MOWING FIELD OR LAWN?**

Now anyone can save time and effort mowing field or lawn, by building their own whirl type power mower.

We furnish complete information, and whirl type blade attachment. Write today.

**T & H Mfg. Co.**
811 E. 31, Dept. E.S.2, Kans. City 3, Mo.

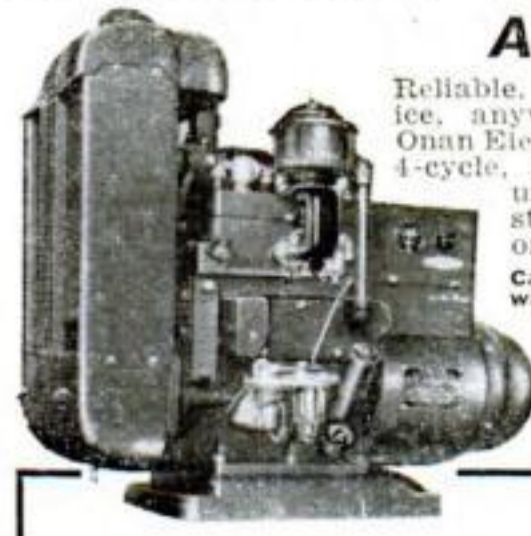


## Arc Welded Design "Know-How"

*Only $3.50 each*
*3 different volumes*
*$10.00 postpaid*

*Each volume contains over 100 welding designs. Write*
**Hobart Bros. Co. Box P-561, Troy, O.**

## ELECTRICITY FOR ANY JOB *ANYWHERE*



Reliable, economical electric service, anywhere, anytime, with an Onan Electric Plant. Driven by Onan 4-cycle, gasoline engines. Single-unit, compact design and sturdy construction. Water or air cooled.

**Capacity range 350 to 35,000 watts, 115 to 660 volts A.C. 50 to 800 cycles 6 to 800 volts D.C. Combination A.C.-D.C. types**

65 different models. Write for folder.

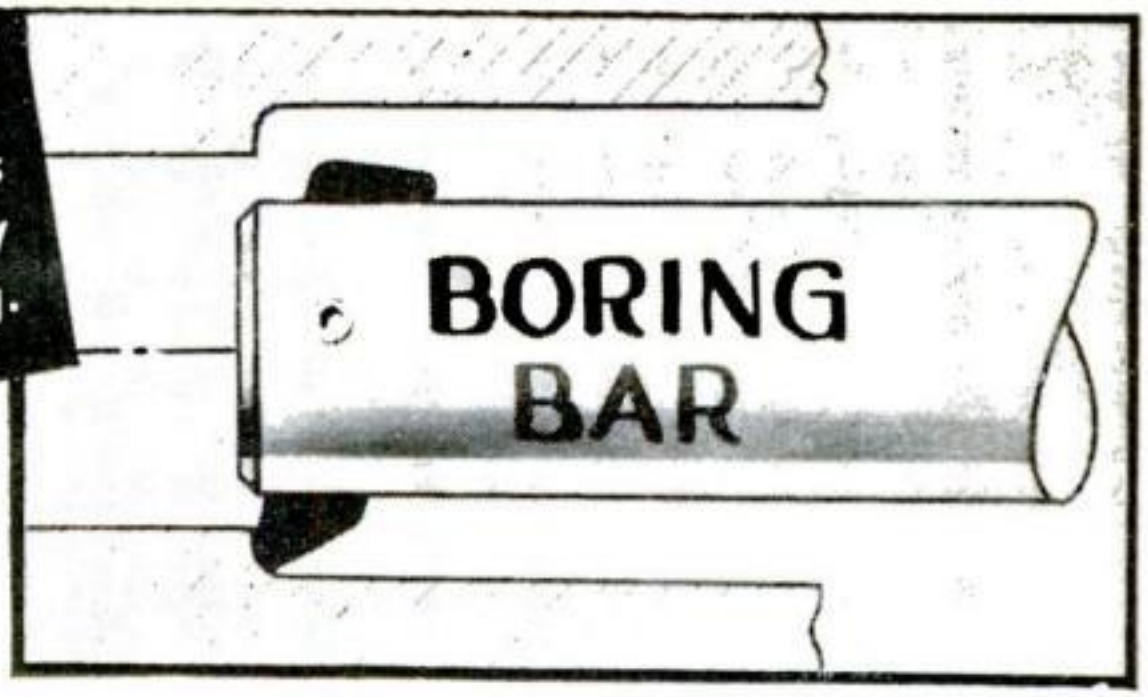
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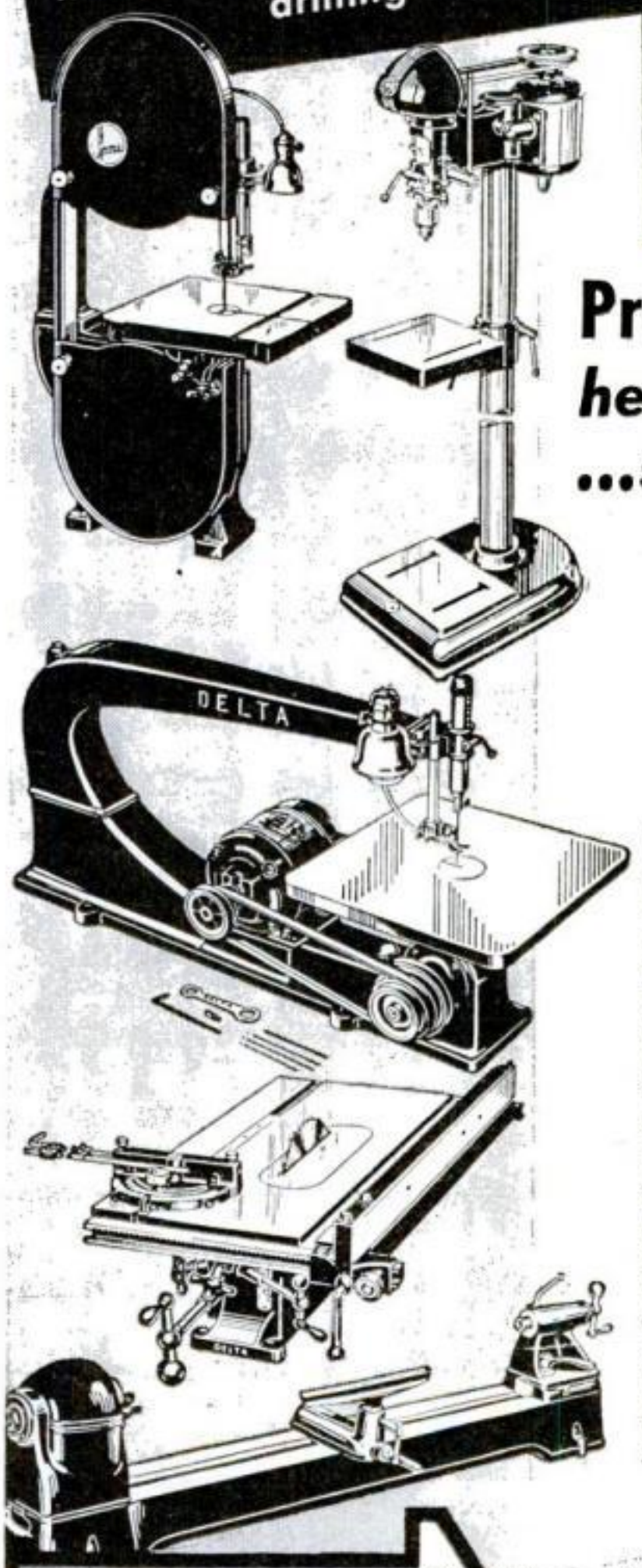
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Rigid boring bar cuts bearing seat accurately. The cut is light, maintaining closer tolerances than are possible with ordinary drilling or reaming.




# Precision-bored Bearing Seats

***help you enjoy greater accuracy ...smoother operation—with your***

**DELTA**
**MILWAUKEE**
REG. U. S. PAT. OFF.

POWER TOOLS

## Other advanced engineering features include:

**Lubricated-for-life Ball Bearings.** You don't have to worry about oiling these bearings. They're *lubricated for life* when they leave the factory. And they are *double-sealed* against harmful dust.

**Pre-loaded Bearings.** This is the result of an extra manufacturing operation that reduces the "play" in the bearings to help you enjoy long-time operating efficiency and accuracy.

**Precision-ground Shafts.** These are shafts built to run without any "wobbling" which may throw off measurements.

**Dynamically-balanced Pulleys.** The pulleys which transmit the power from your motor to your power tool are balanced to help eliminate annoying, damaging vibration.

The accuracy and precision *built into* Delta tools largely replace the manual skill of the old-time hand craftsman. Once you set a tool for the job, it takes care of keeping the work true and straight . . . helps you produce attractive, professional-looking work.

There's a store near you—perhaps right in your own neighborhood — that carries Delta tools. The people there are looking forward to giving you the complete Delta *quality* story. Drop in to see them.

## FREE!

**"Happiness Herald"** —an illustrated tabloid newspaper with facts about woodworking as a hobby. Tells how this popular hobby aids mental health and happiness . . . how it can pay its way. Pictures typical shops and projects. Enjoy its inspiration and ideas. Use coupon.




HM-34

**Tear out coupon and mail today!**

THE DELTA MANUFACTURING CO.
683E E. Vienna Ave., Milwaukee 1, Wis.

*Please send me my free copy of the "Happiness Herald."*

Name.....

Address.....

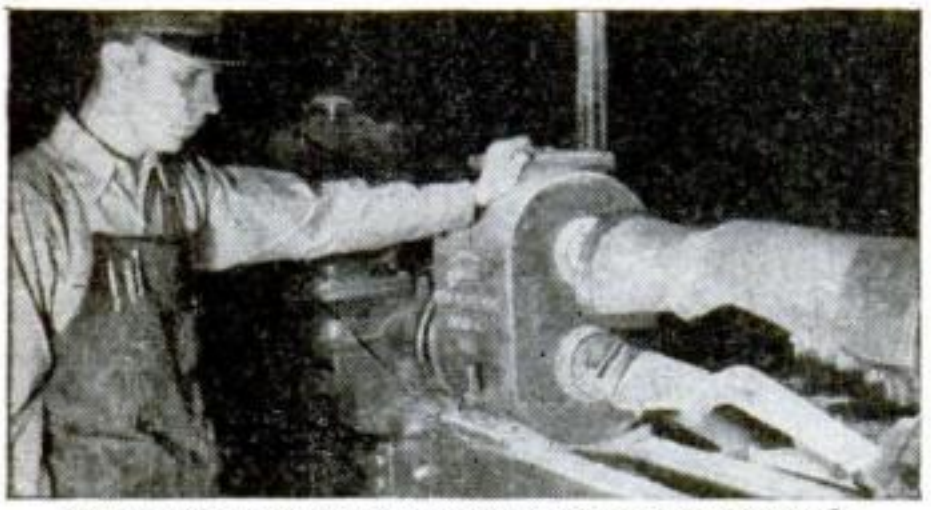
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# THE MAKING OF *Marlin* GUNS

***Marlin brings to sportsmen, through this series of advertisements, interesting facts on gun-making... to enhance appreciation of fine sporting firearms and to encourage their thoughtful handling and care.***



*New automatic electric machines shape Marlin stocks*

**GUNSTOCKS** • Functioning, balance and beauty of firearms are all affected by design and quality of gunstock. Only selected hardwoods go into Marlin stocks. Blanks are turned in new automatic machines which handle sharper, more intricate forms than any hitherto developed. The heavy, cast iron "master" accurately controls triple cutters as the lathe turns. After turning, the stock is "shaped" by skilled craftsmen; sanded, polished, stained and finished.



*Final assembly demands fine craftsmanship*

**ASSEMBLING** • Interchangeable parts make for efficient, economical production. Deft hands and experienced eyes, however, are needed for the accurate work of final assembly.

**TARGETING** • In the four modern ranges at Marlin, expert marksmen target every rifle before shipment. Sights are carefully adjusted until shots group in the center of the bull's-eye.



*Expert marksmen target Marlin rifles*

THE *Marlin*
FIREARMS CO.
NEW HAVEN, CONN. EST. 1870

*(The next advertisement in this Marlin series will reveal more interesting facts on fine gun-making.)*

*Be sure to see Marlin 1946 models on display at your dealer's*




**FIXES**
**BROKEN CHINA**
. . . also glassware, luggage, toys and furniture. It's transparent and waterproof. Makes models, too.




DUCO CEMENT
REG. U. S. PAT. OFF.

**$1 RIDS YOUR LAWN OF UGLY WEEDS!**




**WEED-NO-MORE**
*Magic Weed Killer*
Destroys Ugly Weeds but Won't Harm Common Lawn Grasses!

**NO MORE** back-breaking digging! Destroy ugly leafy weeds with WEED-NO-MORE!

The 8-ounce lawn-size package treats 1600 square feet! Now *you* can enjoy a beautiful weed-free lawn for *only* $1!

WEED-NO-MORE kills dandelion, plantain and other ugly weeds—yet won't injure soil.

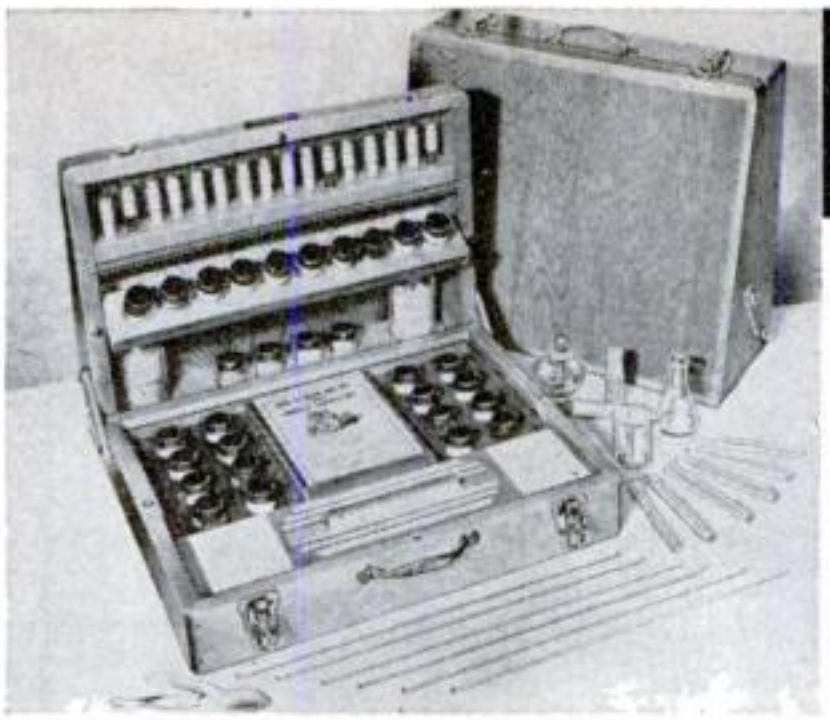
Get it today! Rid your lawn of ugly weeds for only $1. Just spray on . . . WEED-NO-MORE!

On Sale at Paint, Hardware, Garden Supply, Department and Drug Stores

**WEED-NO-MORE**
THE AMAZING NEW WEED KILLER
*Made by THE SHERWIN-WILLIAMS Co. Cleveland, Ohio*




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The Kit Corporation Senior Kit contains chemicals manufactured by Merck & Company, standard textbook on chemistry, Pyrex Erlenmeyer 50cc flask, six chemical test tubes, test tube holder, Pyrex beaker 50cc, six chemical vials, built-in test tube rack, wooden spatula, 100 strips blue and 100 strips red Litmus paper, six 12" strips glass tubing, atomic element and weight charts, chromium plated forceps, alcohol lamp, and 5cc pipette. All these materials contained in a beautifully finished wood cabinet 18" wide x 14" high and depth tapering 7" to 4". Weight 20 lbs. Two bottom trays removable, leaving a water-proof bottom which acts as a chemical resistant laboratory table. **$29.50**

Kit Corporation also manufactures the compact, well-balanced Junior Chemical Laboratory Kit, at $14.95, and the Young Scientist Chemical Labora-toy at **$4.95.**

*This authoritative, 140 page chemical experiment book is part of the kit.*

# *Interested in Chemistry?*

## THIS MODERN, COMPACT, PROFESSIONAL-TYPE CHEMISTRY KIT SERVES AS A PORTABLE CHEMICAL LABORATORY. MERCK & COMPANY CHEMICALS. TOP QUALITY MATERIALS THROUGHOUT.



The atom bomb, the new war-born synthetics, plastics and textiles have focused America's attention on chemistry. To meet this widespread interest, Kit Corporation has produced a complete professional-type chemical laboratory kit to enable hobbyists and students to perform a wide range of experiments. These kits are currently being used by leading colleges and universities to expand their laboratory facilities to care for the greatly increased enrollment in advanced chemistry courses. More and more companies are looking for men who understand the fundamentals of chemistry. Many advanced hobbyists who studied and experimented with chemistry purely for their own amusement have suddenly found that their hobby is paying them big dividends in advancement and more pay.

Write for free descriptive literature and your dealer's name. If your dealer is out of stock, shipment can be made direct to you.



**KIT** *Corporation*

212th STREET AND JAMAICA AVE.
QUEENS VILLAGE, N. Y.

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# CAP PISTOL

# THE IDEAL TOY FOR BOYS!

## "ARMY OFFICERS" .45 REPEATING AUTOMATIC



## FIRES 50 ROUNDS WITHOUT RE-LOADING

**Barrel Actually Smokes When Fired! Easy to Use—Load!**

**Boy-oh-Boy! This is the cap pistol you've been waiting for! It's a large-size model of the Colt .45 Automatic carried by Army Officers during the war. Feels and handles like the real thing! Shoots with a "bang!" every-time you pull the trigger...with or without caps! And listen to this! It's post-war constructed inside and out of long-lasting aluminum and steel, with a beautiful, lustrous plastic grip. Pistol "breaks" open for easy inside loading of caps! Fires 50 rounds—with one loading!**

**MONEY-BACK GUARANTEE! Rush your order today for this amazing realistic repeating cap pistol and ammunition. Use coupon below. Inspect and use pistol for 10 days. If you are not delighted, return it and your money will be refunded. Enclose total amount of your order with coupon. Pistol and ammunition will be shipped to you by express, charges collect. Hurry! Quantity limited! Rush your order now! SANTA SALES, Dept. B-19, 5657 W. Chicago Ave., Chicago 51, Ill.**

Only $1.95

**SANTA SALES, 5657 W. Chicago Ave.**
**Dept. B-19, Chicago 51, Ill.**

Please rush_____"Army Officers" .45 Automatic Repeating Cap Pistols at $1.95 each. _____Boxes of 250 ROUNDS of CAPS at 15c each, or _____ Boxes of 1750 ROUNDS of CAPS at $1.00 each. I enclose $_____ full amount of order. Please ship express, charges collect. If I am not delighted with pistol, I can return it in 10 days and get my money back.

Name.....

Address.....

City.....State.....

### ORDER AMMUNITION

Box of 250 Rounds of Caps . 15c
Box of 1750 Rounds of Caps . $1.00



Have more fun with your repeating cap pistol! Keep a good supply of roll caps on hand.

**CAPS NOT SOLD WITHOUT GUN**

Order blank for additional supplies of caps included with your shipment.

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# STOP DUST

It is no longer necessary to put up with a dirty room every time you sweep the floor. By sweeping with a Dustless brush, which makes its own sweeping compound as it sweeps, you can eliminate up to 97% of germ laden dust in the air between sweepings. You can also do away with costly sweeping compound and cut labor costs. Thousands of factories, shops, offices, schools, and stores now use Dustless sweeping. Get complete facts about this better method of dust control. Write today.

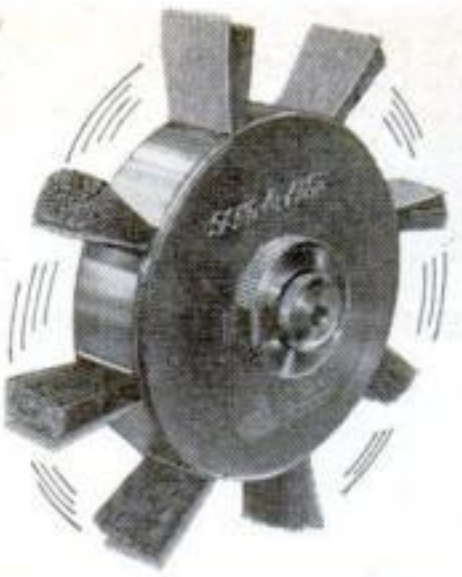



- Dustless
- Speed Sweep
- Speed Wash brushes

**MILWAUKEE DUSTLESS BRUSH COMPANY**

**528 N. 22nd Street • Milwaukee 3, Wisconsin**

FOR A QUICK FINISH— USE THE NEW



# SAND-O-FLEX ALL-PURPOSE SANDER

Here is a low-cost sander that really reaches into recesses, around edges, and handles all those tedious jobs that were formerly done only by hand. Eight bristle brushes "cushion" the abrasive cloth and force it "down in" or "evenly over" all wood and metal surfaces. The central magazine houses the strip abrasive which is fed out as needed. Refill abrasive cartridges are supplied in various grits for all types of work. Loads in less than a minute. Weight 2¾ pounds. Diameter 8", including brushes. Slips onto your motor shaft and produces miracle finishes on curves and contours. See your dealer or write for catalog today.

**SAND-O-FLEX CORPORATION**
4373 Melrose Avenue • Los Angeles 27, Calif.



# TENNIS SAVE on our LOW PRICES

• Gut Tennis and Badminton Strings direct from factory to you. • Vises & Frames • Tennis Equipment.

**H. E. WILLS CO.** Catalog FREE
1047 W. 47 St.
Dept. PS-56
Chicago



**NOW** **CHANITE SELF-WELDING FLUX—REPAIRS all ELECTRIC HEATING ELEMENTS.** So simple anyone can make repairs in your broken or burnt-out electrical appliances—irons, toasters, stoves & etc. Guaranteed nothing like it. From our mines to your appliances. **$1.00** per package. **$7.50** per doz. Stick form **25c. $2.00** per doz.
**CHANITE SALES COMPANY, 914 South Main, Fort Worth 4, Texas**

# TRAILER AXLES, HITCHES, AND PARTS



• If you are interested in purchasing trailer axles, hitches, and other trailer parts, contact us promptly.
*Write for free literature*
**HAMMER BLOW TOOL COMPANY, Dept. D-9, WAUSAU, WIS.**



# NEW TINY POCKET SIZE RADIO!

Slips in your pocket or purse—**Wt. only 3 ozs!** Complete READY TO PLAY as shown with self contained phone for personal use. Smooth durable black and silver plastic case. **Has patented fixed Crystal-Slide Tuning Dial!** NO TUBES, BATTERIES, OR ELECTRIC PLUG IN REQUIRED—Little up-keep cost—Should last for years—USUALLY RECEIVES LOCAL BROADCASTS without outside aerial wires.

**GUARANTEED TO WORK**
when connected and used according to instructions sent with each radio. Can be used in homes, offices, hotels, cabins, in bed after hours, etc.

**Send Only $1.00** (cash, money order, check) and pay postman $2.99 plus delivery fees on arrival or send $3.99 for postpaid delivery. IDEAL GIFT FOR CHILDREN OR ADULTS ALIKE! NEWEST PRACTICAL NOVELTY! Get your PA-KETTE RADIO NOW for real enjoyment. Order today—NOW! Dealers in most cities.
PA-KETTE ELECTRIC CORPORATION Dept. PS-5 Kearney, Nebraska



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# The O'BRIEN ALL-STEEL HYDRAULIC BUMPER-JACK

## Built to Lift 2 Tons

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### *With Finger-Tip Pressure*

**LATEST, FINEST ENGINEERED, MOST RUGGEDLY CONSTRUCTED JACK ON THE MARKET • A LIFE-TIME ACCESSORY • • •**

1—All Steel Construction.
2—Solid Steel Piston—3 Telescoping Steel Tubes Quadruples its strength.
3—Adjustable Hook-Over 15 inch range.
4—Finger Pressure Hydraulic Stroke.
5—No Screw Parts To Rust.
6—17¼ inch Hydraulic Hoist. Leakproof.

**LIFETIME GUARANTEE AGAINST DEFECTS. PERFECT WORKMANSHIP.**

**$13.50** F. O. B. Chicago

If your dealer can't supply you, remit $13.50 and we will ship immediately. Money cheerfully refunded if not satisfied.

***Wanted:* DEALER-AGENTS**

**AUTO PRODUCTS CO.**
Dept. S-5
6349 N. Clark St., Chicago 26, Ill.

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**arc welding** manual *and* text book...$2.00

• Teaches you how to become an arc welding operator — one of highest paid trades today. Write today!

**Hobart Bros. Co.,** Box P-562 Troy, Ohio

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**Low Price**



FREE Details

## The OTTAWA "Buzz" Master

**CLEARS LAND FAST!** Powerful 6-HP motor with friction clutch for safe operation. Cuts down timber, brush and hedge; turn blade vertical; saw logs to length. Can be equipped to fell largest trees. Has clutch pulley for belt work; guaranteed.

**OTTAWA MFG. COMPANY, 501 Brush Ave., Ottawa, Kans.**

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**Say You Saw It In Popular Science**

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# SAVE HANDS SAVE TIME




## with Steel-Grip Gloves

With not a moment to be lost, keep men at work and materials moving with Steel-Grip chrome tanned cowhide gloves. Steel ribbons over tough leather strips; palm and fingers reinforced, for utmost wear. Handle rough, heavy, sharp materials with speed and safety and sureness. Or what's your problem? Over 4300 proven Steel-Grip safeguards may give you an *immediate* answer. Used by big industrials since 1910. Write for catalog or state your need today.

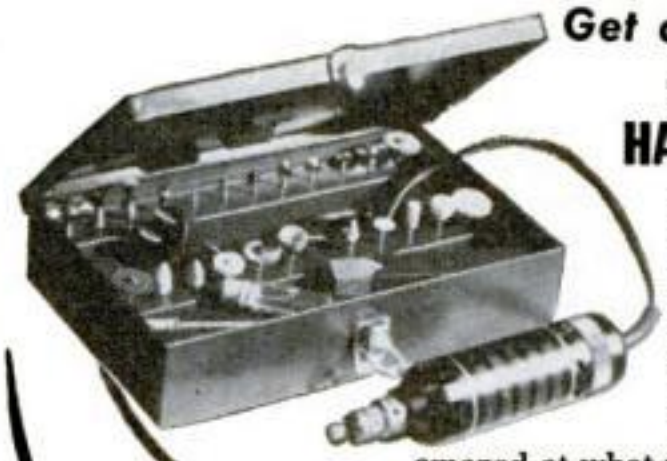
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653 Garfield Blvd., Danville, Ill.
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Smooth, steady power at your fingertips! You can turn out professional looking projects for pleasure or profit—ship, plane or train models, costume jewelry, wood carvings, puppets, initialed tumblers, etc. Handee, first small portable tool and today's finest, uses 300 different accessories. AC or DC. 25,000 r.p.m. Weight, 12 oz.

WITH 7 ACCESSORIES, POSTPAID **$18.50**



### *Get a Good Start Get the* HANDEE KIT

HANDEE Tool and 45 of the most popular accessories, all packed in handsome, compact steel carrying case. You'll be amazed at what you'll accomplish! Complete, postpaid **$25.00**

FOR YOURSELF OR A FRIEND... THE GIFT OF A LIFETIME!

## NEW PRECISION ATTACHMENTS

Fit DeLuxe Handee only. Enable novice or craftsman to perform precision operations not possible with other portable tools. Magically, easily, your offhand carving, routing, shaping, etc. is perfect as to depth of cut, accuracy of line. Set of 6 attachments with instructions, postpaid **$7.95**



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FREE 64-PAGE Catalog

**CHICAGO WHEEL & MFG. CO.**
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**CHICAGO 7, ILL.**

Send me ☐ HANDEE TOOL ☐ HANDEE KIT ☐ PRECISION ATTACHMENTS ☐ REMITTANCE ENCLOSED ☐ SEND C.O.D. ☐ SEND 64-PAGE CATALOG.

Name.....

Address.....



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# ANCO RAIN-MASTER

## "Dead-Locker"

**WINDSHIELD WIPER ARMS and BLADES**




(A war-born invention—by ANCO—first for military aircraft—now for your car.)

## DON'T SHOOT YOUR GAS-PUMP MAN!

He's doing the best he can. Sure, he knows how dangerous it is for you to drive your car . . . in stormy weather . . . with your dull old windshield wipers that smear and smear. He'd gladly put on for you quickly a pair of keen new ANCO RAIN-MASTER Wiper Blades and Arms. He has them—Newest Models! But he forgets to remind you? Too busy? You can't shoot him for that!




After all, it's *your* car to protect. So *you* remind *him*. Get RAIN-MASTERS ...patented features...original equipment on many makes of high grade cars and trucks . . . used in war—on our fighting tanks and trucks and ships and bombers too...because ANCO RAIN-MASTERS clean quicker, clean cleaner . . . last longer. May save you a costly smashup.

Ask for RAIN-MASTER Windshield Wiper Arms and Blades next time you buy gas.

**THE ANDERSON COMPANY**
*Established 1918*
GARY, INDIANA

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# Save 1/2

## MAKE YOUR SPARE TIME PAY!

**Assemble These Beautiful Home Furnishings Yourself**

***NO TOOLS . . . NO WORKSHOP NEEDED!***

Your spare time is worth money! Make these smart, modern furnishings for your home . . . or as luxurious gifts for your friends! Styled by Paul Hudson Stanley, nationally known designer, these ultra-new accessories combine the natural beauty of clear-grained Harvest Oak and the trim lines of sparkling Lucite!

**IT'S EASY AND IT'S FUN!**

A tabletop Hobby! Each beautiful accessory comes in *complete* Kit form. All parts and materials of selected woods and gleaming Lucite are accurately pre-cut and ready for assembly. Nothing to cut, carve or shape . . . NOTHING ELSE TO BUY! Step-by-step instructions guarantee easy assembly, beautiful results!

***HERE'S HOW YOU SAVE ONE-HALF!***

Leading stores now feature *identical* items at assembled retail prices exactly DOUBLE your cost for complete Hobby Kits! You SAVE ONE-HALF . . . make your spare time PAY by building these articles with your own hands! For Pleasure and Profit . . . write today for free details of this enjoyable new Hobby!

**HOMECRAFTERS GUILD Dept. F-5**
**360 N. MICHIGAN AVENUE • CHICAGO 1**

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# DIE-LESS DUPLICATING




Many small parts can be formed without dies, to duplicated accuracy of .001" with DI-ACRO Precision Machines, — Benders, Brakes, Shears. Save die expense and time delay. Ideal for experimental and research work, making samples, models, etc. as well as regular production runs.

**Write for descriptive literature.**

**O'NEIL-IRWIN MFG. COMPANY**
342 8th Ave. South, Minneapolis 15, Minn.

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# REPAIR FURNITURE

*WITH THE GLUE THAT MANUFACTURERS USE*

## FRANKLIN GLUE

*GENUINE LIQUID HIDE GLUE*

**READY-TO-USE**




Makes joints stronger than the wood itself. No mixing — No heating — No unpleasant odor — No chilled joints.

THE FRANKLIN GLUE CO., COLUMBUS 15, OHIO

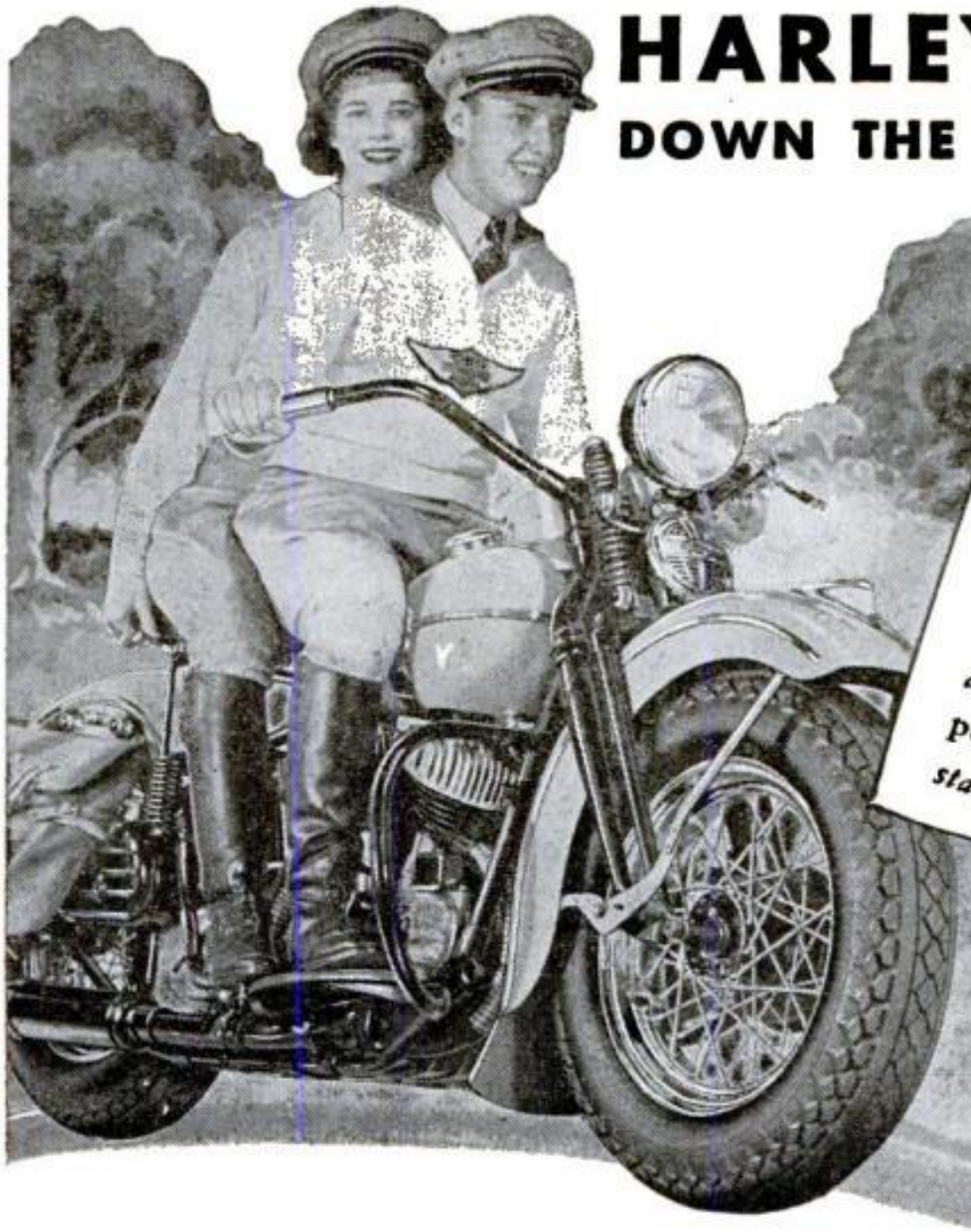
AT YOUR HARDWARE DEALER



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# RIDE A NEW HARLEY-DAVIDSON

## DOWN THE ROAD TO HAPPINESS



*Here's a letter that's typical of many received:*

"Have an order for a 61OHV with my home dealer — for delivery about the time I hope to be discharged. Many pleasant memories were left behind when I entered the service. I know how anxious all riders are to get astride a dependable Harley-Davidson and *start down the road to happiness.*"





THAT letter tells the whole story! Thousands of enthusiasts are eagerly looking forward to good times in the world's greatest sport — motorcycling! Be ready to ride *your own* NEW HARLEY-DAVIDSON on fun-filled vacation trips — or take in race meets, hillclimbs, endurance runs and other thrill-packed motorcycling events! See your Harley-Davidson dealer EARLY — and send the coupon NOW!

# HARLEY-DAVIDSON *Motorcycles*

**HARLEY-DAVIDSON MOTOR COMPANY, Dept. PS, Milwaukee 1, Wis.**

Please send at once free copy of 24-page "Enthusiast" Magazine, filled with motorcycle action pictures and thrilling stories.

*Name*.....

*Address*.....

*City*.....*State*.....






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# TWO FAMOUS LINES - NOW BEING MADE IN Nylon




## *The Top in Casting Lines*

World-famed Black-Oreno is back—in Nylon! Hard braided, waterproofed, exceptionally smooth, it's easy to cast and has the great long-lasting quality for which this dependable line is famous. 6 tensile tests: 12, 15, 20, 25 and 30 pound.




## *The Top in Fly Lines*

Excel-Oreno has always been known for long wear and dependable service. Now braided of Nylon, finished with exacting, painstaking care, Excel-Oreno is now your best *investment* in fly lines. Level lines, H to C, in 25-yard coils. Double tapers—HEH, HDH and HCH—30-yard coils.

**LINE-ORENO NYLON IS BACK, TOO!**

This original South Bend Nylon casting line is an unusually serviceable line of exceptionally long life. 12, 15, 20, 25 and 30 pound test.







**FISHING PHOTO BOOK — FREE!**

Send for this 48-page book packed with fishing *action* photos—all prize winners in the South Bend Bait Company Fishing Photo Contest.

**SOUTH BEND BAIT COMPANY**
**892 S. High St., South Bend 23, Indiana**

# SOUTH BEND

*A Name Famous in Fishing*

# Here We Go!



Cushman MOTOR SCOOTER

OVER 75 MILES PER GAL

The CUSHMAN, during recent years, has proved itself to be so amazingly useful and economical that the demand, today, is terrific. If you want a CUSHMAN this season, we urge you to see your dealer or write us—IMMEDIATELY!

**POWERFUL:** 4 H.P. engine—new low and high gear supplies power for steepest hill. Floating Drive applies power smoothly. **ECONOMICAL:** 400 miles per $1 worth of gas! **SPEEDY:** Up to 35 miles an hour! **COMFORTABLE:** Special springing, long wheel base, balloon tires. **SAFE:** Low center of gravity, heavy brakes. Durably constructed of finest materials. Thousands in use.

Made in several models for carrying extra passenger or heavy loads. Standard, shown above (windshield and tandem seat are extras)—or 3-wheel Side-Kar or 3-wheel Package-Kar.

*Write* See your CUSHMAN dealer. Or, send for full details on all models. Send Today!

**CUSHMAN MOTOR WORKS, Dept. S-14 Lincoln, Nebr.**

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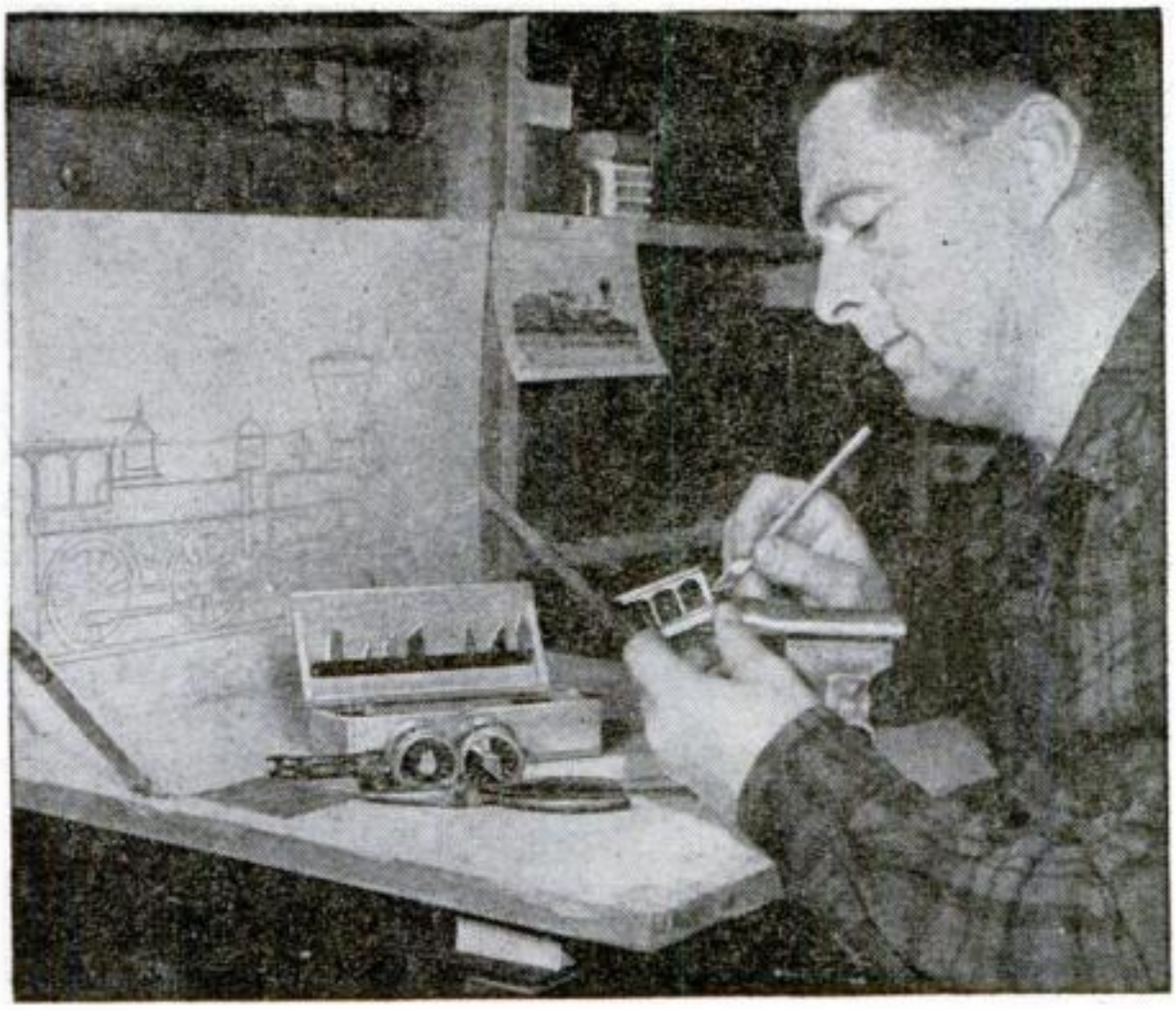


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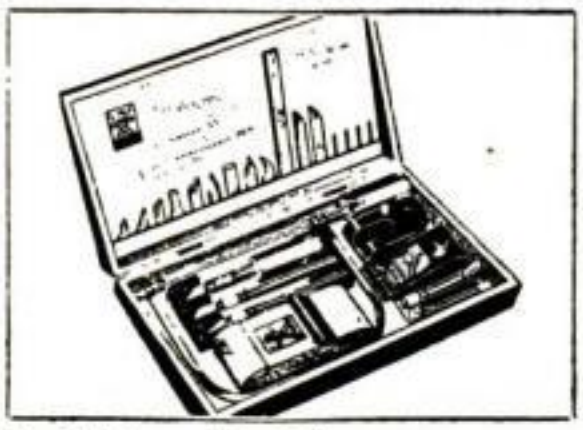
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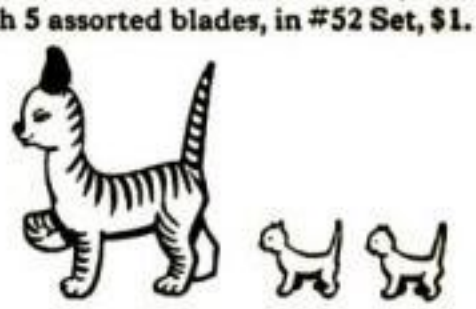
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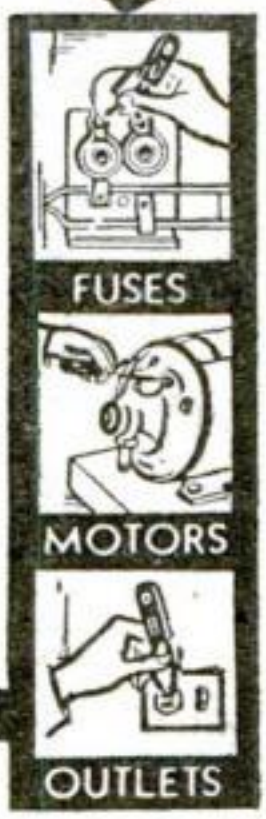


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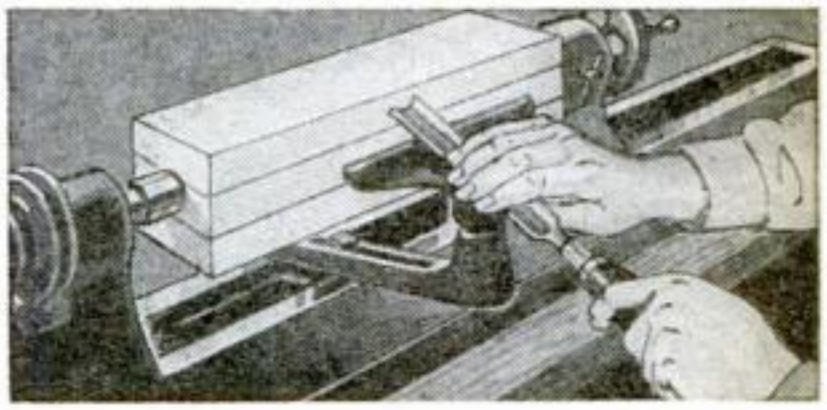




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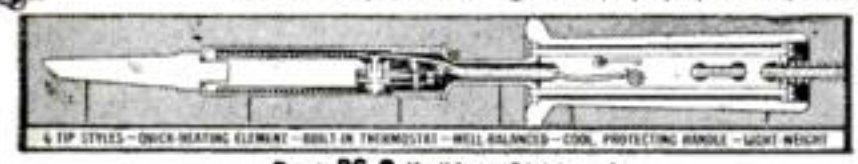
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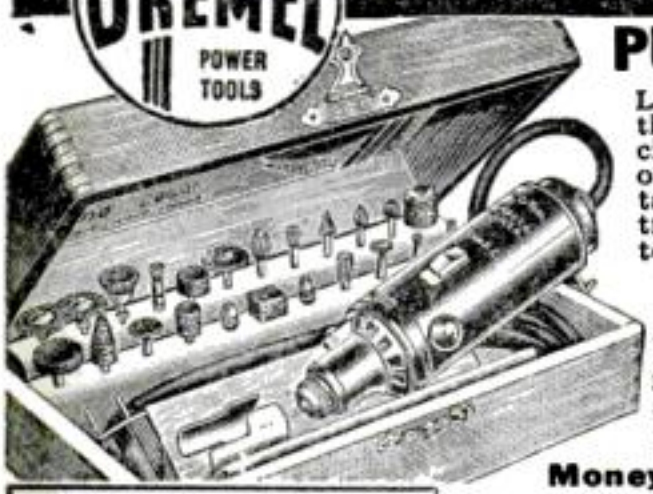
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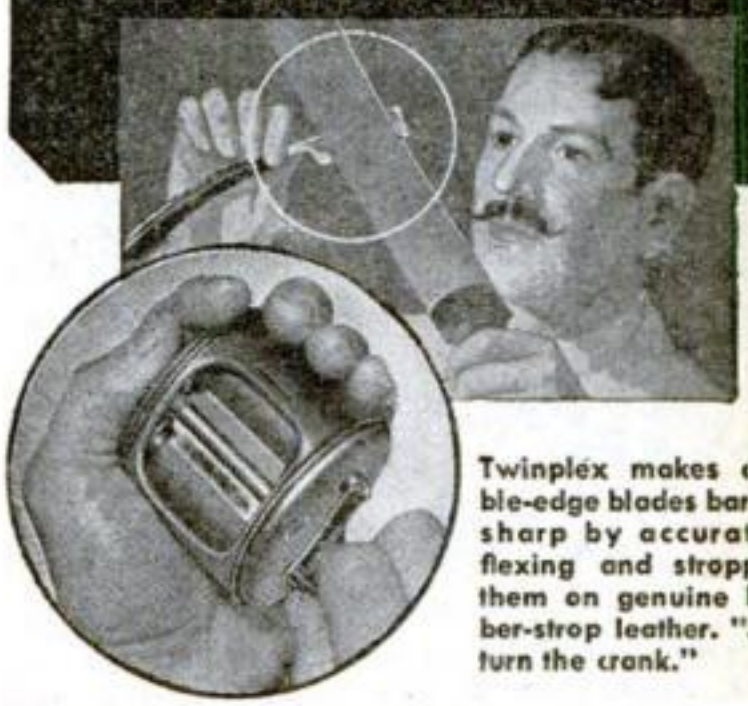
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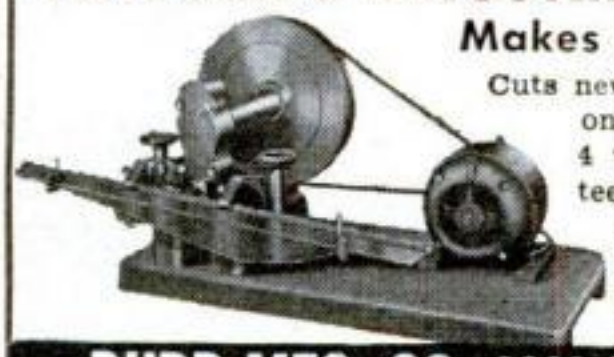
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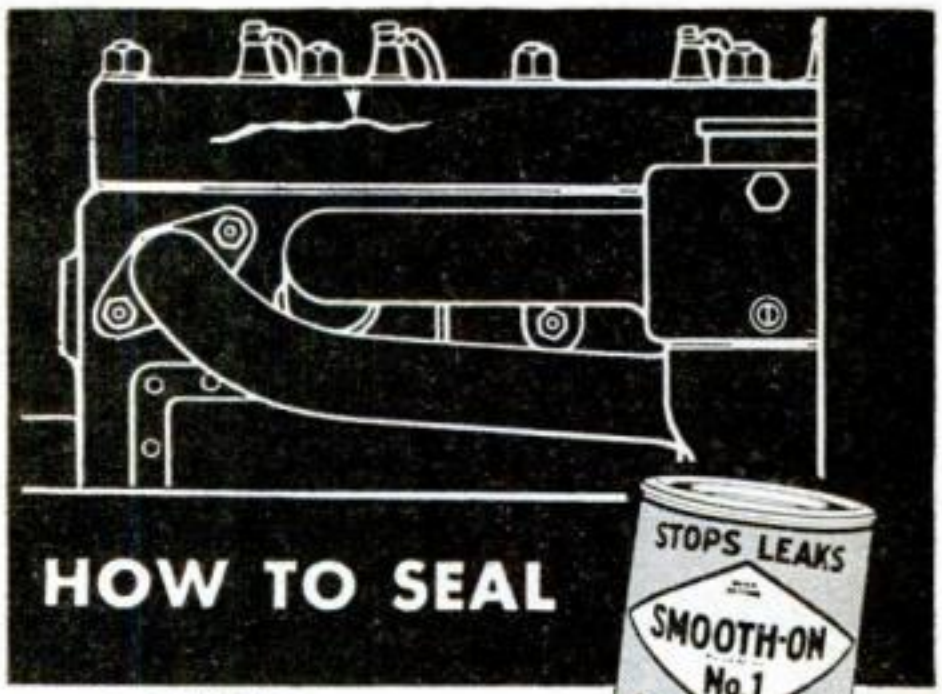


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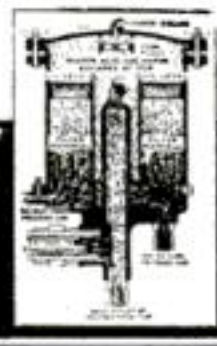
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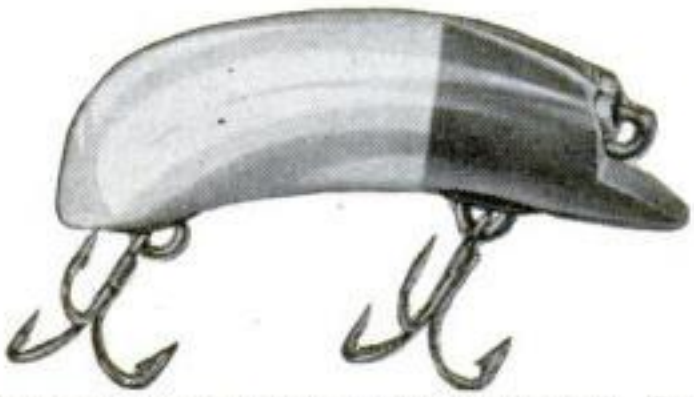
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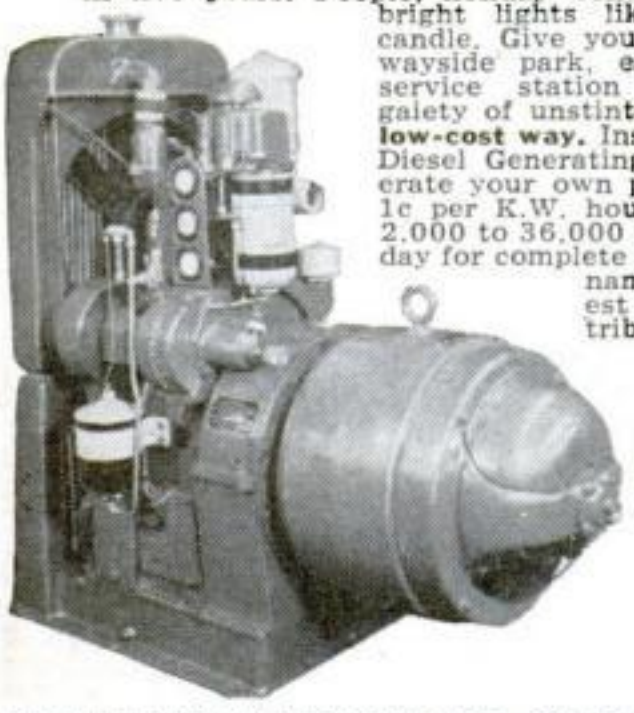
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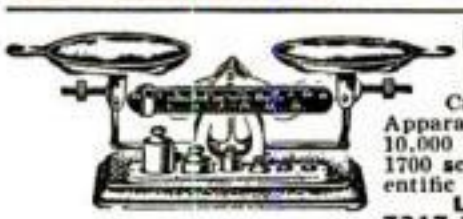

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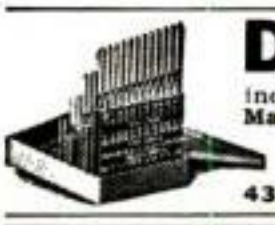
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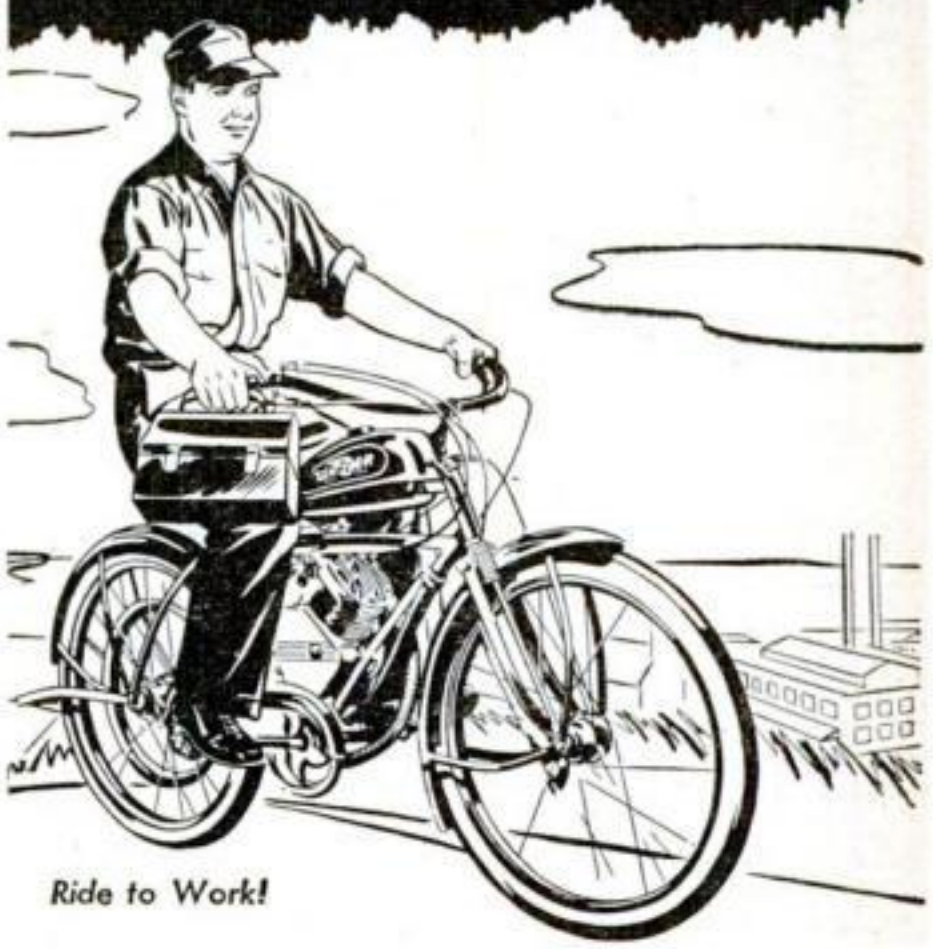
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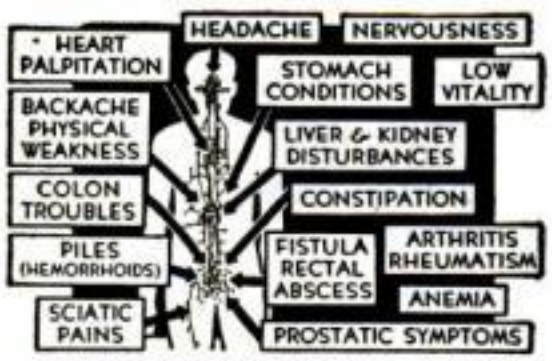


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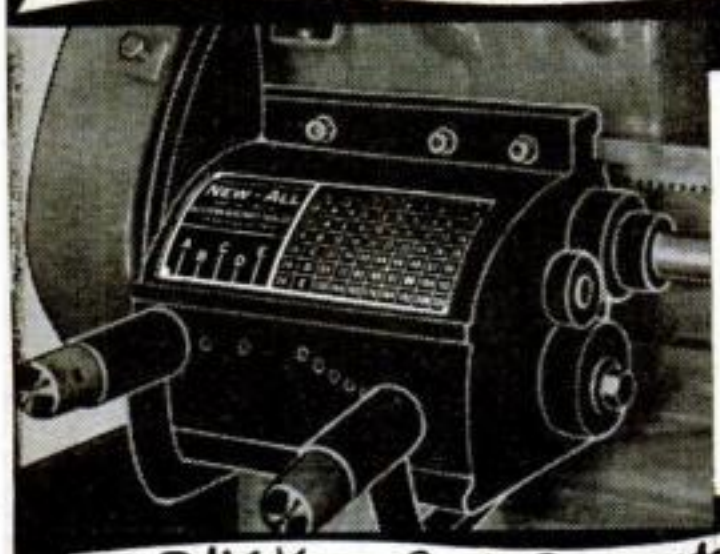



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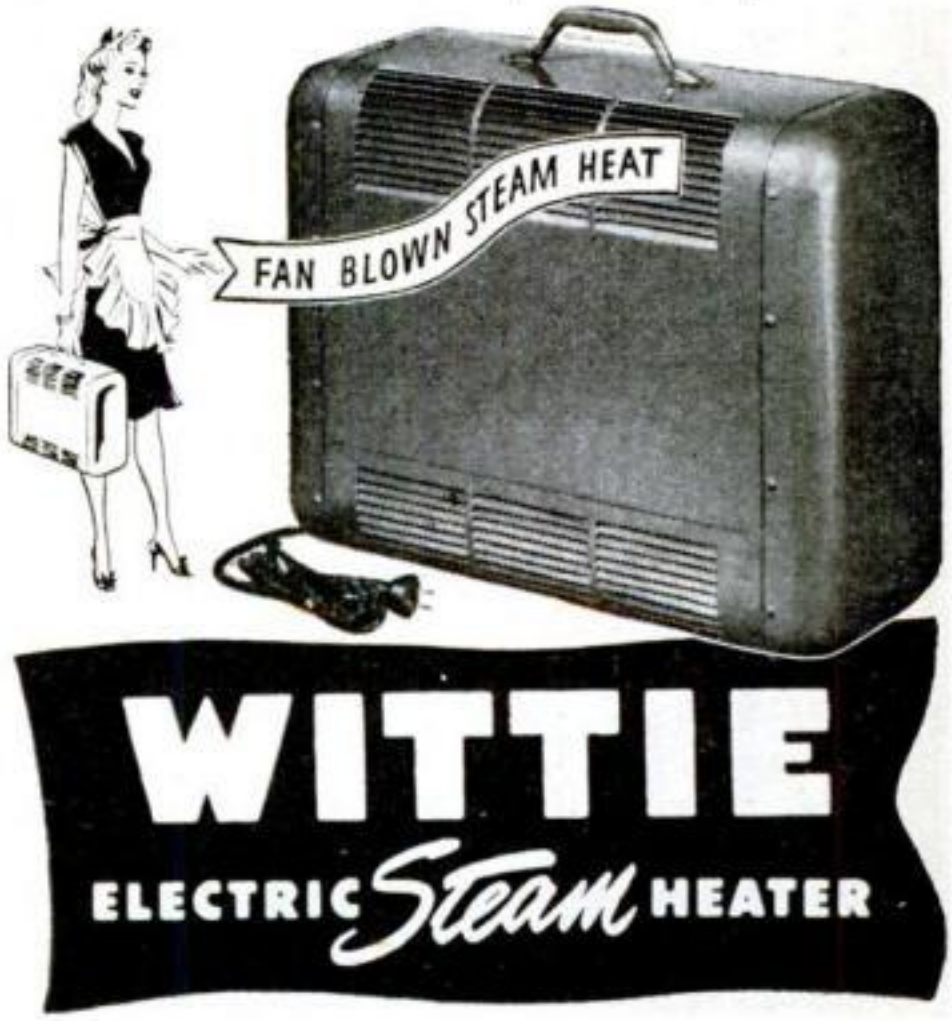
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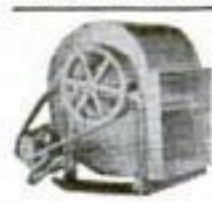
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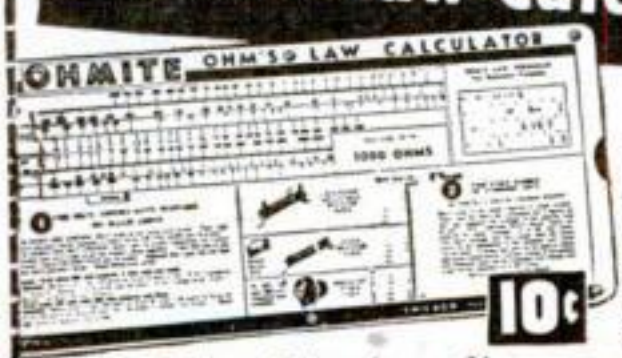
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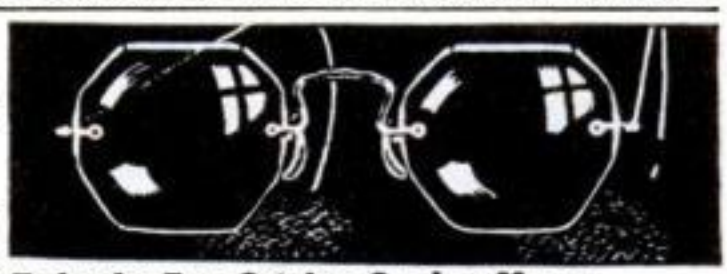
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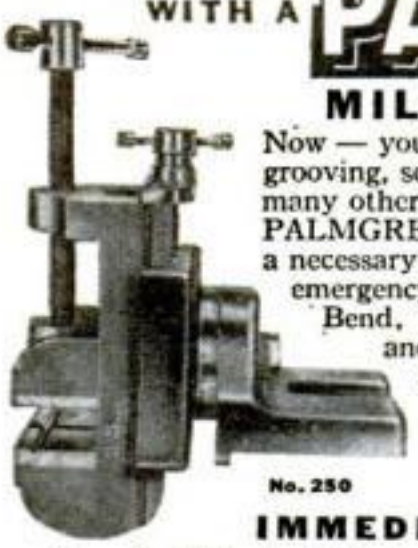
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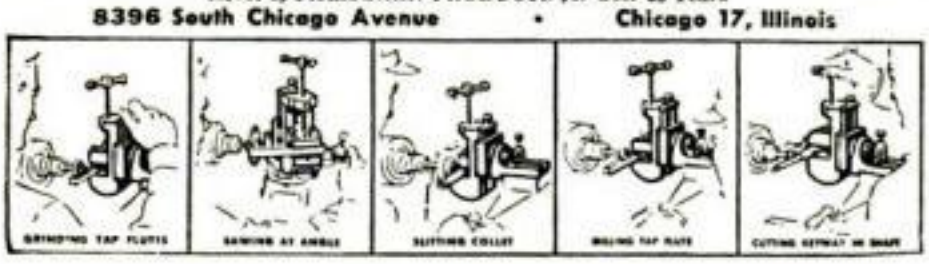
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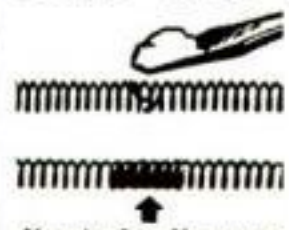
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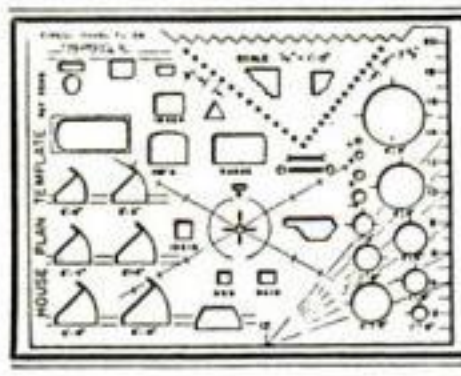


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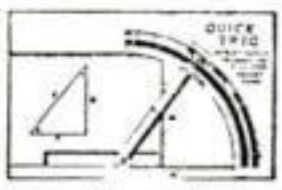



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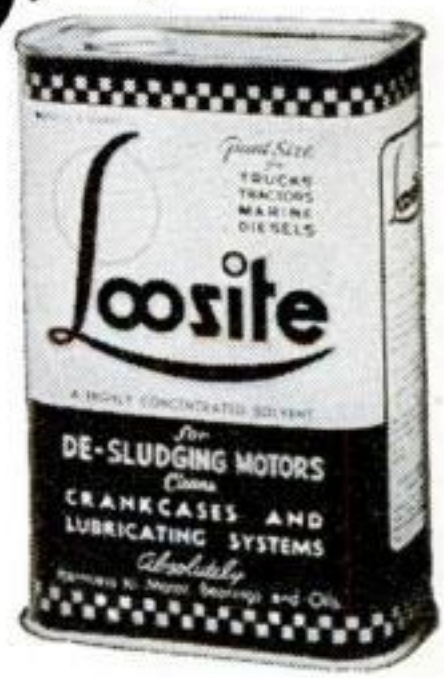
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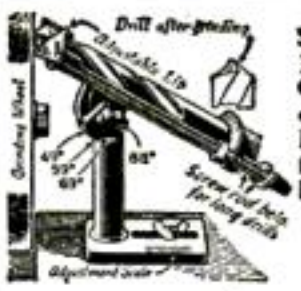
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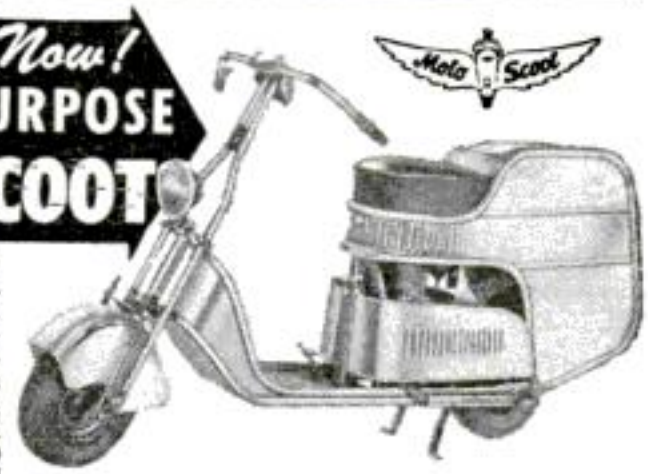
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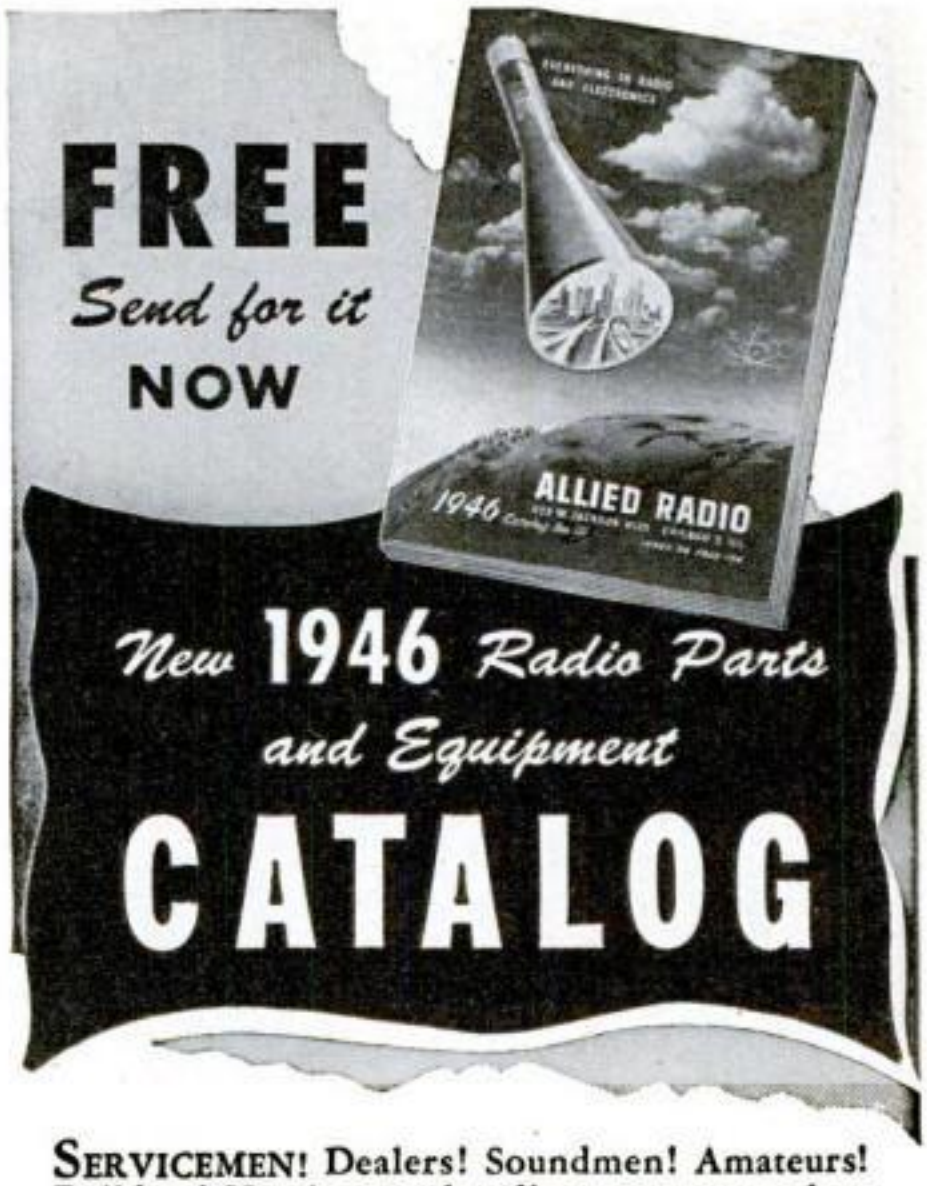
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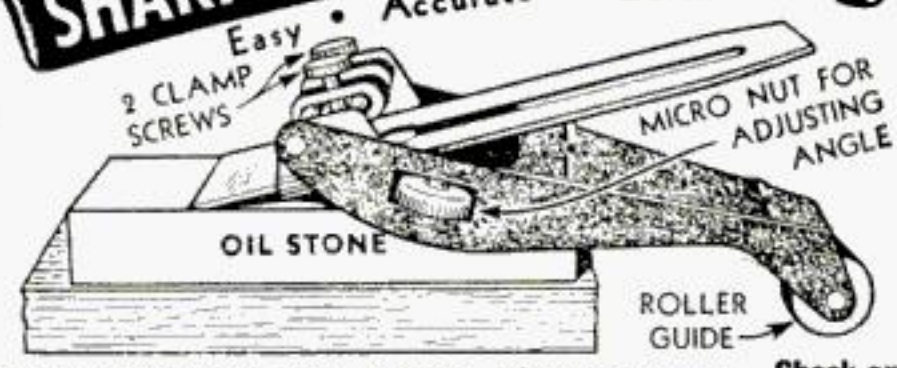
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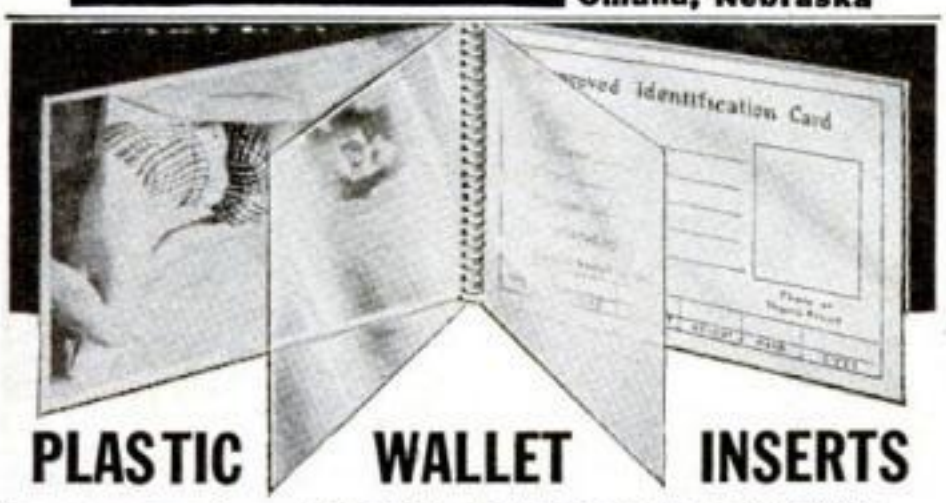
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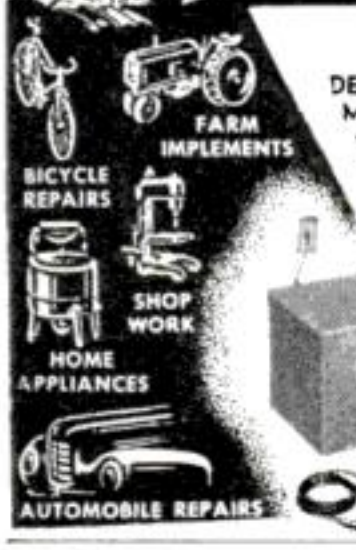
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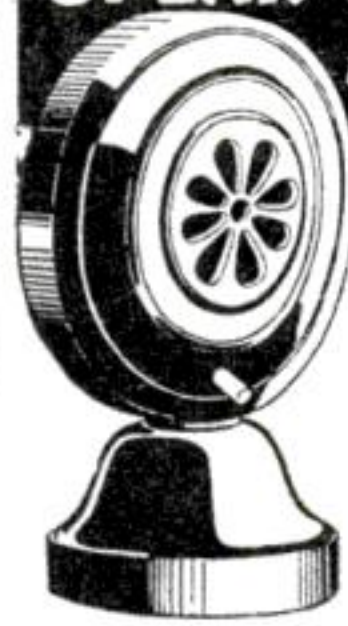
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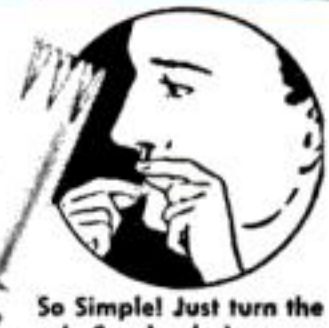
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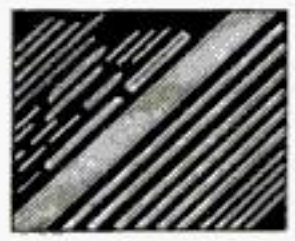
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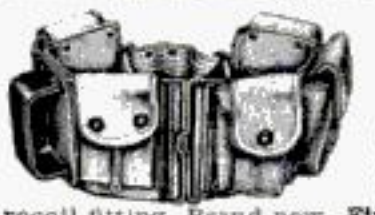
## MESS KITS

Regulation Army Mess Kits. Ideal for campers, boy scouts, etc. Slightly used but guaranteed perfect. Two pieces. Folding handle.



**A-116**—Each . . . . . **69c**

## GI POCKET BELTS



Of heavy canvas. Adjustable waist size. Each with 5 pockets and metal recoil fitting. Brand new. Fine for hunters, boy scouts, etc. Wgt. 3 lbs. **A107** **98c**

## 7-LB. EXPERIMENTERS PARTS ASSORT.



A "gold mine" for the radio serviceman. Hundreds of valuable radio parts, new radar and electronic parts and subassemblies, coils, resistors, screw machine parts, etc.—worth many times this low price.
**A130R**—7 LBS. **$1.79**

## CANTEENS, CUPS & COVERS

Regular U. S. Gov't issue canteens. Plastic screw top cap chained to body. Slightly used.



**A117**—METAL BODY. Each . . . **69c**
**A118**—PLASTIC BODY. Each . . . . . **69c**
**A109**—Canteen Covers, New. Each . . . . . **69c**
**A119**—Canteen Covers, Used. Each . . . . . **35c**
**A120**—Canteen Cups, Used. Each . . . . . **25c**

## MICROPHONE BUTTON



Brand new! For experiments in radio, electronics and other electrical apparatus. Used in telephone, amplifier and detectaphone work. Diameter 2½ inches. New.
**A512**—EACH . . . . . **98c**

## AMMUNITION BOX

Fine for storing valuables, carrying lunches, etc. Of heavy gauge 7½x11x4 inches. Fireproof. Hinged lid with folding handle. Olive drab finish. Used, but perfect. Shipping wt. 4 lbs.



**A525**—EACH . . . . . **25c**

## PLASTICS—LUCITE AND PLEXIGLAS

In sheet form. Good workable sizes. Transparent. For costume jewelry, etc. Easy to work and polish. Shp. wgt. 6 lbs.
**A280**—5 LB. ASST. . . . . **$4.75**

## CATALAN—ASST. COLORS

Extruded shapes, rounds, half rounds, etc. Easy to machine. Furnished in assorted colors, shapes and lengths. Shp. wgt. 6 lbs.
**A281**—5 LV. ASST. . . . . **$4.75**

## U.S. Govt. BOLO KNIFE



Extra heavy. For farm, home or jungle use. Blade of Gov't. formula cutlery steel. Walnut riveted handle. 3½ inch hilt. 10½ inch blade. You'll find hundreds of uses for a Bolo knife. Blade will take and hold a keen cutting edge. Wt. 2 lbs.
**A112**—with Army Sheath . . . . . **$4.95**
**A212**—Leather Sheath, extra . . . . . **$1.50**

## PUP TENTS



Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition Fine for campers, outdoorsmen, boy scouts, etc. Grand Xmas gift for children.
Wgt. 8 lbs.
**A1**—Tent Only . **$3.95**
**A110**—Tent, new . . **$7.95**
**A101**—Ropes, wooden poles and stakes for above. Per set . . . . . **$1.00**

## BIG SHIPS BELLS



Purchased from U. S. Maritime Comm. Measures 10 inches high, 9¾ inch flare. Big 6 inch clapper. Weight 15 lbs. Fine for farms, clubs, estates, etc. All new. Ship. wt. 10 lbs.
**A541**—ONLY . . . . . **$9.85**

## PROF. TELEGRAPH KEY

Purchased from the gov't. Finest design and construction. Base measures 3x4¾ inches. Original value $2.50. All parts of instrument brass. Adjustable.



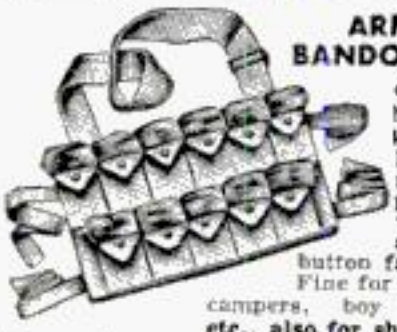
**A147**—Each . . . . . **98c**

## MEDICAL STERILIZER



Consists of alcohol burner and sterilizing tray in hinged metal case 1⅞ x 1⅛ x 2⅝ inches. Burner may be used separately. Bright nickel finish. All brand new.
**A125**—Each . . . . . **98c**

## ARMY BANDOLEERS



Of fine heavy khaki. Big roomy pockets with snap button fasteners. Fine for hunters, campers, boy scouts, etc., also for shop work in carrying small parts, etc. Material alone is worth this price. Shp. wt. 1 lb.

11 Pocket Type No. 129 EACH **49c** | 5 Pocket Type No. 110 EACH **29c**

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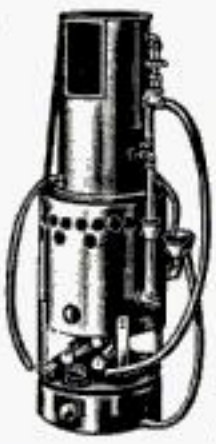
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## STILLS



Distill your own water with one of these fine portable stills. Purchased from the Gov't. Completely self contained. Has 1 gallon capacity; output 1½ gal. per hour. Fitted with genuine Coleman double burner stove. Operates 5 to 7 hrs. on one filling. Heat output 20,000 BTU's. Stove alone is worth this price. All new and guaranteed. Instr. included. Weight 109 lbs.
**No. 206** Each . . . **$59.50**

TO: Reader
FROM: Editor

# PACKAGING the pieces . . .

PUBLISHER Godfrey Hammond likes to define editing as "the big dream plus infinite patience with the little pieces." Certainly any publication, whether crossroads weekly or million-copy magazine, has to have a big idea. And it has to express that idea with a mosaic of small pieces: the uncounted combinations of the alphabet; the pieces of type; the thousands of dots of metal that transfer a photograph to the printed page; the even tinier dots of ink that make color printing possible.

The big dream, for *Popular Science Monthly*, began 74 years ago. It was the vision of a blind man named Edward Livingston Youmans. He saw science, then, as something that affected people who might not understand scientific jargon but who should know what it meant. He enlisted such hallowed scientific workers as Herbert Spencer and Thomas Huxley to popularize science.

Today, science hits the headlines of the newspapers, is featured in the biggest magazines, crops up in every conversation. And because science is popular, Popular Science is bigger. But PSM's big idea is still to convey the *meaning* of science to those who refuse to be confused by the *words* of science.

Science hasn't made editing any easier, however. It has mechanized Gutenberg and Daguerre. But until a writer can think into some kind of scope and have the words spray automatically onto the paper we writers, artists, editors, engravers, paper makers and pressmen will have to continue chopping ideas into little pieces and then wrapping them in the covers of your magazine.

Take Leon Shloss, whose by-line you have seen on several important PSM stories recently. In this issue you can hardly see his name except on the masthead. But Shloss is invisibly written on a lot of stories, which he carpentered and polished into more interesting and enjoyable shape for you.

Or take Wes Griswold, whose name has not yet appeared at the head of an important story in PSM only because he has been too busy as head of the copy room. Griswold's is the thankless job of coordinating the flow of all the many pieces into the three-quarters of a pound of science and mechanics on paper that the postman crams into your mailbox or you lift from the newsstand. Griswold's is the responsibility of seeing that the biggest ideas fit the inexorable limits of type, and that your name is spelled right if we print your letter to the editor.



**Godfrey Hammond** comes of a long line of sea captains. Following service in World War I, he worked for Munsey, the *New York Tribune*, and on *Popular Science Monthly* for a time. He then became publisher of *Christian Herald*, but returned to Popular Science Publishing Company nine years ago, and for the past seven years has been President. Father of five children, he gets small credit as a patriarch since there were two sets of boy twins —brought up on Popular Science.



**Leon Shloss**, a basketball addict, has played over a thousand games, won honorable mention in the 1928 All-America when he was at The American University. He taught history and coached basketball at Penn State, worked in Washington for International News Service. He left INS as aviation editor to start public relations machinery for the aircraft industry. Then the Navy called him to get press work going for naval aviation. He traveled some 200,000 miles by plane and warship showing the American press the war.



**Wesley S. Griswold** was a reporter, feature writer, and Sunday magazine editor on the venerable and respected *Hartford Courant* for 11 years before he went with Travelers Insurance Co. in public relations. In the Army in '42, he went through OCS, was soon writing and editing technical manuals for the AAF, eventually became a captain. By extracting the facts from two expert pilots, he wrote the training manual for the P-61, but never got a chance to ride in one.



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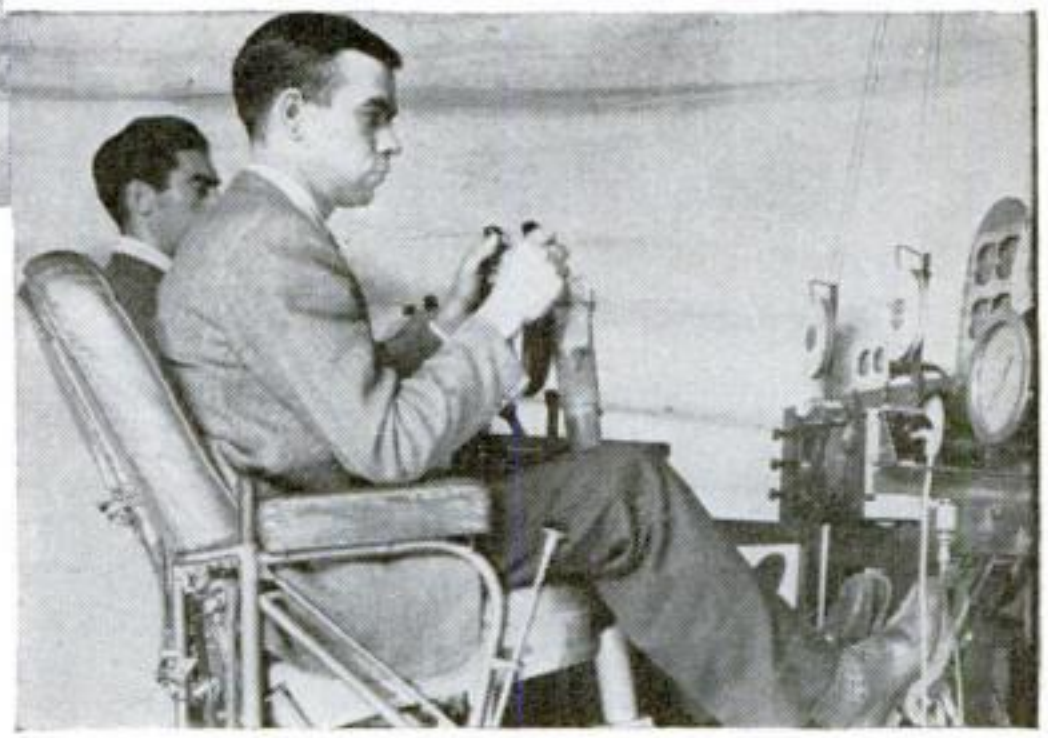
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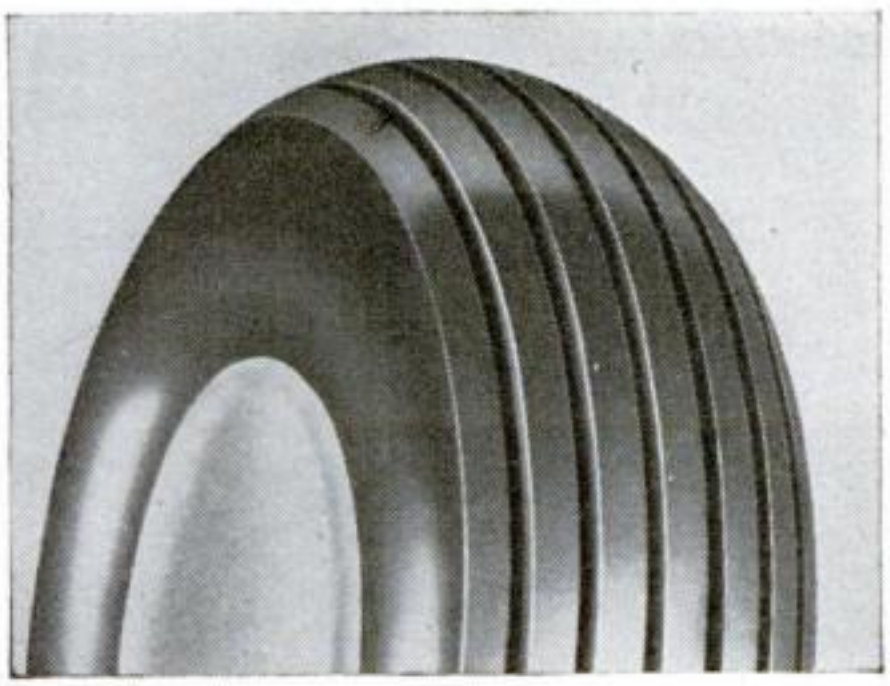


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# SOUTH BEND LATHES

## ESSENTIAL SHOP EQUIPMENT

South Bend Precision Lathes are accurate, versatile, dependable. Their ability to perform a wide variety of operations on all metals and other machinable materials make them essential tools in all types of maintenance, repair, and experimental shops as well as in toolrooms and production plants.

## 9-INCH LATHE FEATURES

Fine workmanship by highly experienced machine tool craftsmen.

Superfinished spindle with large bearings.

Belt drive for smooth, quiet operation at high speeds.

Back-gear drive for power and low speeds.

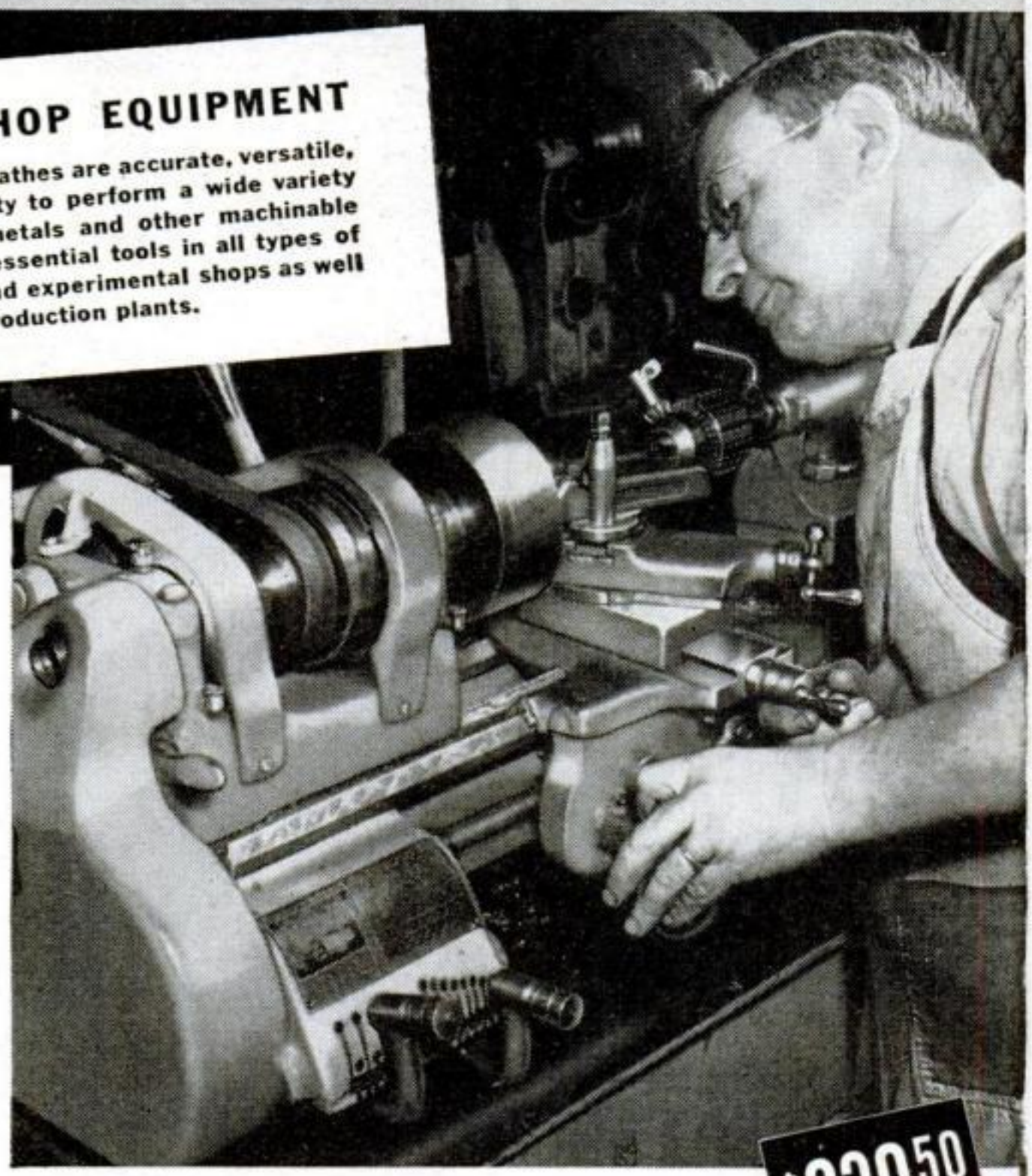
6, 8, 12 or 16 spindle speeds.

Thread cutting range (Model A)—4 to 224 per inch, 48 pitches.

Precision lead screw for thread cutting.

Worm drive and friction clutch for power longitudinal and cross feeds (Models A and B).

Three hand-scraped V-ways and a flat way on bed to insure perfect alignment of headstock, saddle and tailstock.



9" x 3' South Bend Model A Precision Bench Lathe with 12-Speed Drive, less electrical equipment and bench,

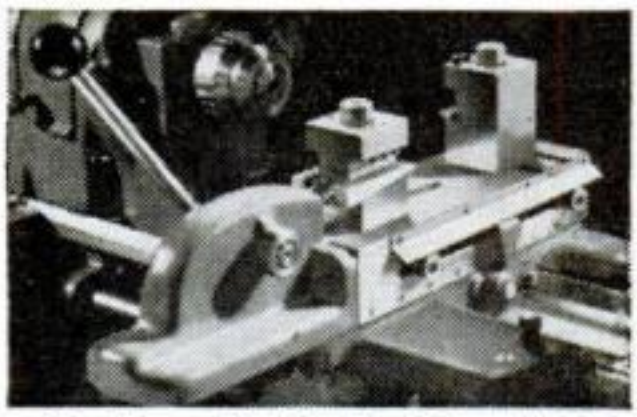
**$239.50 F.O.B. FACTORY**

South Bend 9-inch Precision Bench Lathes are widely used, both in small shops and in large factories. They perform difficult precision jobs easily and with unfailing accuracy on all types of materials from tool steels to new light metals and plastics. They are fast, easy and economical to operate. Dependable service and long life are designed and built into them. South Bend Lathe prices are moderate and operating costs definitely are low. If you plan to equip a shop soon, or to increase or replace your present equipment, write today for a catalog and the name of your nearest South Bend Lathe distributor.



***Write for Catalog***

**South Bend Precision Lathes are made with 9", 10", 13", 14-1/2", and 16" swings. State size lathe in which interested when writing for catalog.**



**Handlever Double Tool Cross Slide**

This attachment permits a three tool set-up which speeds successive operations in production work. The complete line of South Bend Attachments and Accessories are shown in Catalog 77. Write for it.

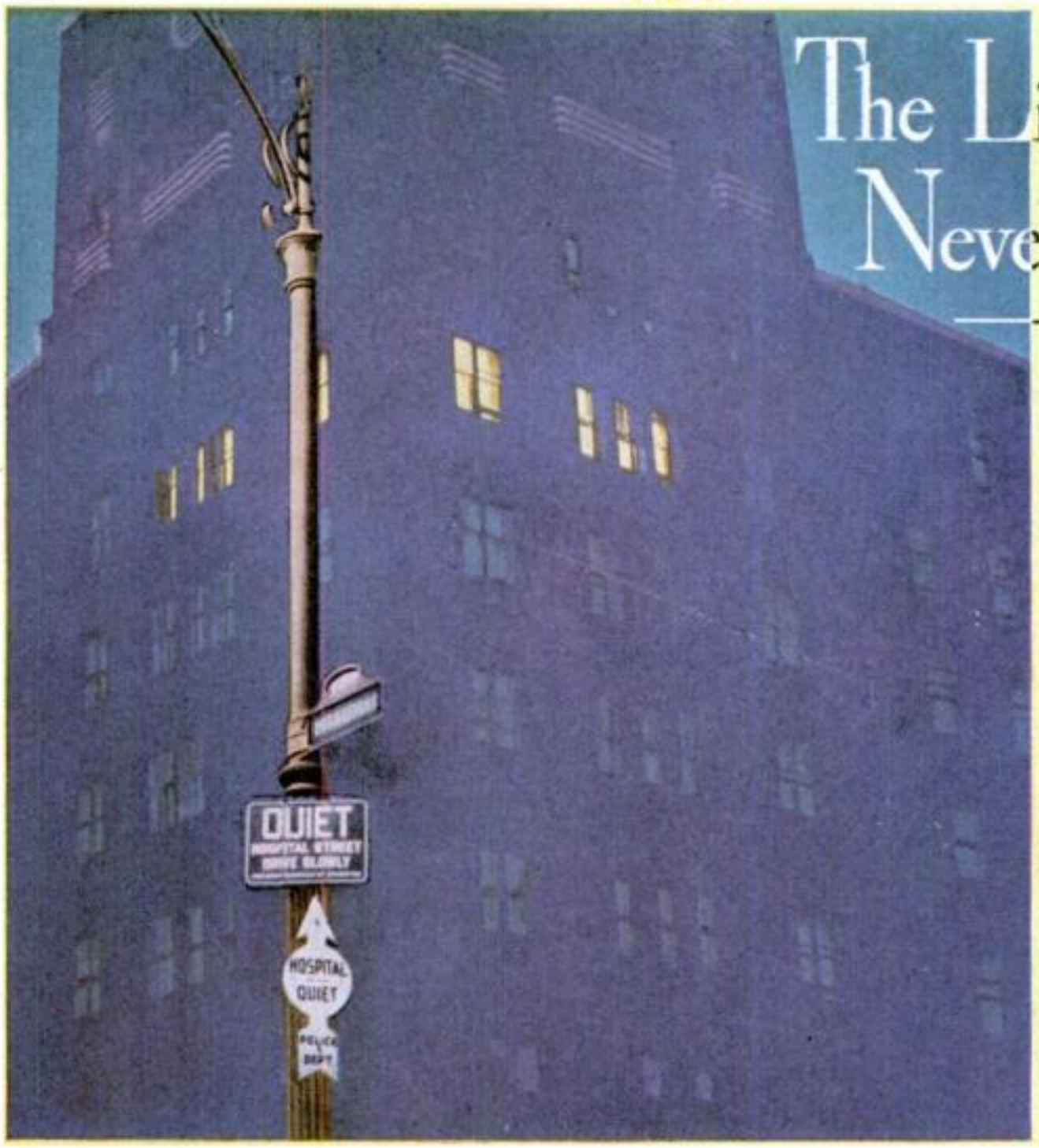
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***"Emergency Case!"***

***While the city sleeps, lights blaze in a hospital ward —they mean "Doctors at Work!"***

HE ISN'T interested in making speeches and taking bows on the magnificent job he does. He's just interested in doing that job with all the skill and devotion he possesses.

His work is never done. His battle knows no lulls. But he asks no quarter. All this he knew when those proud letters "M.D." were first affixed to his name.

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*According to a recent Nationwide survey:*

# *MORE DOCTORS SMOKE CAMELS THAN ANY OTHER CIGARETTE!*

● "WHAT CIGARETTE DO YOU SMOKE, DOCTOR?"

Three independent research organizations recently put that question to 113,597 doctors. Family physicians, nose and throat specialists . . . doctors in every branch of medicine were asked. More doctors named Camel as their smoke than any other cigarette.

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CAMELS *Costlier Tobaccos*



**THE "T-ZONE" TEST WILL TELL YOU**

The "T-Zone"—T for taste and T for throat—is the proving ground for any cigarette. For only your taste and throat can decide which cigarette tastes best to you . . . how it affects your throat.




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Actual Size 7" x 10"






1st Captured Jap Photos of Our Navy

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